THE GLASS INDUSTRY

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THE GLASS DIVISION MEETS AT SKYTOP

Scientific society goes "practical" and program draws many from the production departments. Sports and social features contribute to success of meeting.

The Glass Division of the American Ceramic Society held its tenth annual summer meeting at Skytop Lodge, Pennsylvania, September 8-10. An even hundred and twenty registered; a normal attendance, but this year more than usually representative of the entire industry, and incidentally preponderantly glass rather than supply men. The "practical" nature of the program attracted a number from the production departments.

The opening session on Friday was devoted mostly to a symposium on Defects of Glass, notably cords and stones. This was followed in the afternoon by an informal discussion of Methods of Chemical Analysis, presided over by Dr. Lundell. The final session on Saturday constituted a symposium on Chemical Durability. The papers reflected a preparation and presentation fully comparable to that attained at the annual meeting.

Selection of Skytop Lodge as a meeting place could not fail to result in enhancing the social features which have come to be identified with all meetings of the Division. The golf tournament resulted in a photo-finish and was won by O. G. Burch, Owens-Illinois. The trophy was a magnificent piece of Steuben ware, the gift of Hartford-Empire Company. Bowling on the green, billiards, ping-pong, bridge and other in- and out-door sports filled the spare hours. An informal get-together dinner Saturday evening, presided over by Ronald Lester of Maryland Glass Corporation, was outstanding for the brevity of its speeches. Guests of honor included President Andrews and Ross Purdy, from the American Ceramic Society.

Turning to the formal program of papers, Dr. Kreidl brought with him several specimens of opaque glasses showing cordy defects. He pointed out that a good many changes take place in glasses of this type which do not occur with transparent glasses. Opaque glasses are not single-phase; and in the separation of some of the components in crystalling phases, it is to be expected that the homogeneity of the glass may be greatly disturbed.

This paper led, naturally, to the work of Dr. Weyl and Mr. Turnbull, who are doing some very interesting things in the identification of cords by a staining method. When a piece of glass is immersed in a molten mixture of silver nitrate and sodium nitrate certain ionic changes occur resulting in the introduction of silver into the glass where it becomes manifest by its yellow, orange, or red color.

Since internal cords are the result of local differences in chemical composition, which in turn produce different silver stains, it becomes possible not only to intensify optical effects, and make the cords more distinctly visible, but also eventually to correlate these color differences with differences in composition, and thus to identify the cords with their excess or deficiency of certain of the oxides in the parent glass. Thus far, not many distinctive conclusions have been reached in this interesting approach, but it may be recognized that strongly reducing conditions accentuate the silver stain, particularly with respect to such substances as iron oxide, arsenic oxide, and sulfur.

Some excellent color photographs of ring sections of bottles were exhibited. Some of these were taken by polarized light without staining, and again of the same specimens after staining, bringing out the emphasis in color resulting from the entrance of silver.

Dr. Fraser, of Bausch and Lomb, gave an interesting account of the methods in use for the production and examination of optical glass. A moving picture of the stirring machine at work was especially revealing to the rest of us, who must take far more casual methods of providing for reasonably cord-free glass. Slides showing the apparatus for viewing optical glass by monochromatic light in suitable immersion liquids demonstrated the care that is necessary in the final selection of this product. An actual viewing apparatus and slabs of polished optical glass were also displayed. From the standpoint of the makers of optical glass, it seems that cordiness is the natural condition to be anticipated from the nature of the molten material, and that the removal of cords by adequate stirring is an absolute necessity. No attempt was made to specify the nature of the cords, or to suggest that any method of mixing raw materials or conducting the melting process could result in their elimination.

The principal features of the paper by Dr. Thompson, of the Harbison-Walker Refractories Co., were some excellent photomicrographs of glass stones. These brought out the typical crystal forms of the common stones such as divitrite, tridymite, critstobalite, and nephelite as they appear in ground and polished specimens of such inclusions. The most surprising picture was that of a kyanite stone entering from a piece of refractory, where the kyanite had in some mysterious way escaped inversion.

These papers and the discussion which they aroused pointed in the direction not only of identifying cords and stones for what they are chemically, but also of spec-

ifying their sources and thus giving some hope of establishing their origin, and pointing out means for avoiding them. The staining work, in particular, is frankly only a report of progress, but it seems to offer high promise as a new and very revealing treatment.

A group of thirty or more spent two profitable hours with Dr. Lundell, Friday afternoon, hearing the summary of the work done by cooperative laboratories on the sample of glass recently circulated by the National Bureau of Standards, and also discussing the method adopted for the examination of glass sands.

It is evident that the rapid method recently developed for glass analysis, in which a number of samples are weighed out for different groups of components, are yielding excellent results, and that the several laboratories are able to check each other very well indeed. The dehydration of silica by perchloric acid instead of hydrochloric seems to be a superior method. But it was emphasized by the leader that two evaporations are still necessary. In connection with the method for glass sand, application to sands of high alumina content requires only that smaller samples be taken in order to provide an adequate amount of alumina for accurate analysis.

This particular session took on the character of a rather intensive seminar on silicate analysis and we hope that "Professor" Lundell will continue these helpful interpretations.

The Saturday morning session on Durability was concerned with two phases of this study: the accurate estimation of the quantity of alkali removed from the glass by the digestion liquid, and the correlation of such measurements with the actual behavior of the glass containers.

The Thesis Work of Robert F. Doran at Alfred, as presented by Dr. Scholes, showed that the Beckmann p_H meter furnishes a rapid method for estimating the alkali dissolved in the attacking solution which is not only fully as accurate as titration with the use of an indicator, but which also gives an opportunity for removing samples which can be returned to the digestion flask, so that the effect of time can be studied on a single glass sample.

A thorough and clean-cut study of seven different indicators and the end points which they represent, as compared with true end points of titration as obtained by the potentiometric method, were charted by Finn and his associates at the Bureau of Standards. Dr. Lundell presented this report, which showed that brom-thymol blue, because of its sharp color change and suitable p_H is most favorably regarded by these investigators as an indicator for use in these very dilute solutions.

Mr. Burch of the Owens-Illinois Glass Co. reported an extended study of the behavior of glass in contact with alcoholic solutions, with particular reference to gin. Results as to the appearance of flakes after long storage of such solution in bottles of various composition were not always easy to check against the durability tests on the same bottles. It was pointed out that the original p_H of these alcohol solutions in beverage form had a great deal to do with the eventual attack on the glass.

It seems that we may be hopeful about the development of rapid tests of durability which will mean something definite as compared with storage tests on actual bottles. A. K. Lyle of the Hartford Empire Co. presented figures and charts indicating that the powder method at selected temperatures will give results agreeing with the general behavior of the same composition in contact with water at room temperature over extended periods of time.

Our guest speaker at this session was Dr. A. B. Carter of the Abbott Laboratories, who spoke from the consumer's point of view concerning what is needed when delicate pharmaceutical preparations such as serums are stored in ampoules and other types of containers. He saw the glass maker's problem as one of producing glass of high durability coupled with easy workability at a sufficiently low cost.

Summaries of Technical Papers

Inhomogeneities in Opaque (Fluorine and Sulphide) Glasses. *By N. J. Kreidl, Dunkirk Glass Works.*

There are inhomogeneities which are special to two phase glasses. Inhomogeneities of the glassy phase are not quite as noticeable in two phase glasses (opaque glasses) as in clear glasses since they are covered up by the opacity of the glass due to the light scattering power of the crystalline or colloidal phase distributed on the glass. However, some inhomogeneities of special character may be decisive for the homogeneous appearance of such two phase glasses.

The main factors ruling homogeneous appearance of two phase glasses are the solubility of the two phases in each other and the rate of precipitation of the one phase from the parent melt. This applies to all different kinds of two phase glasses such as more particularly glasses in which the one phase is crystalline (fluoride glasses), or colloidaly dispersed (sulfide glasses), or to glasses in which the two phases are formed by immiscibility or other glasses in which both phases are amorphous. The rate of precipitation again is governed by the rate of formation and number of nuclei and by the crystal growth or aggregation of colloidal particles respectively. Accordingly local changes in composition or physical conditions may influence these factors.

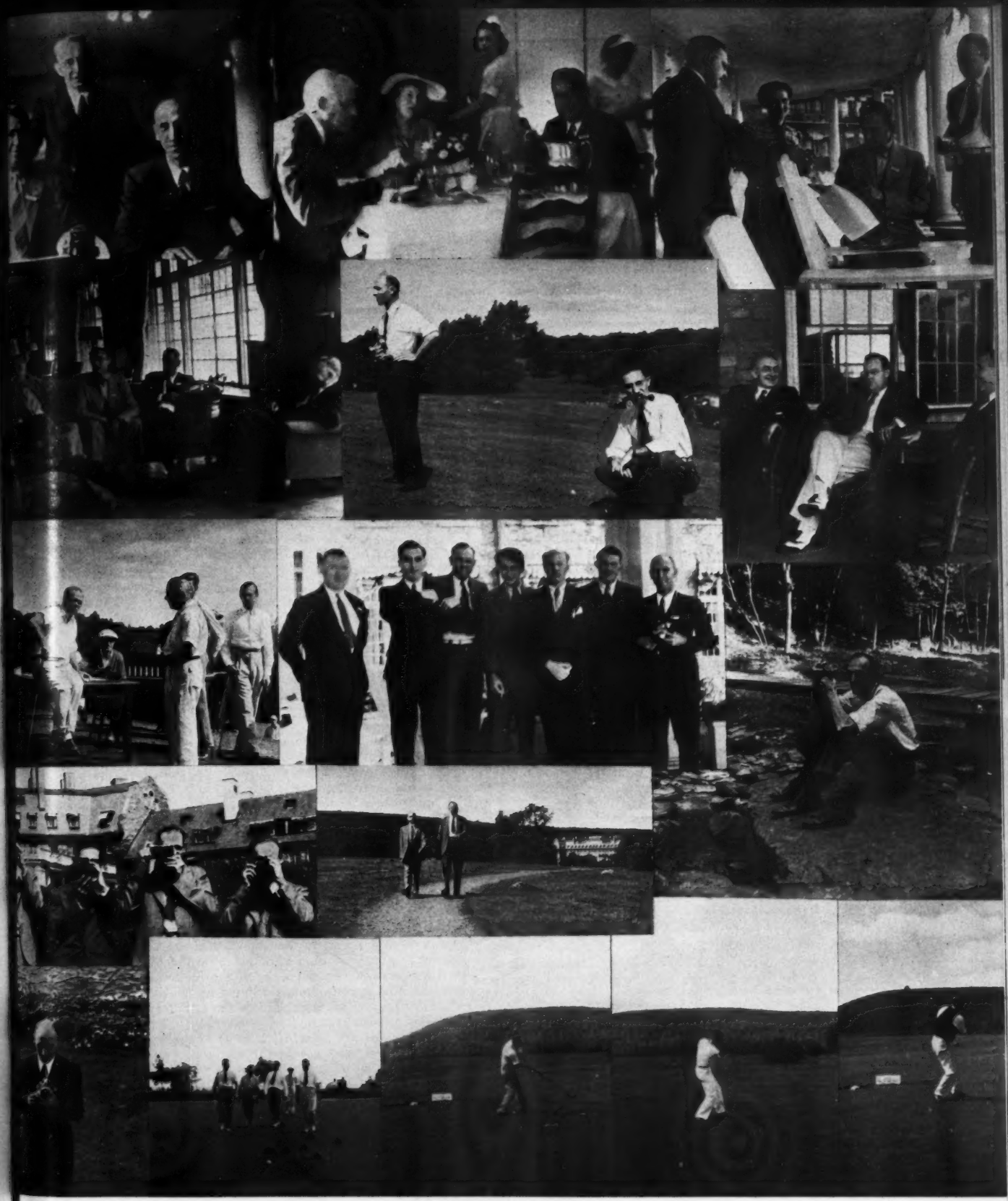
Experiments on plant scale showed the marked influence of two and three valent oxides on these factors. Local differences in composition with respect to these oxides cause inhomogeneities in the form of lines, streaks, zones and patterns of different opacity.

The factors governing solubility and precipitation are also strongly influenced by temperature effects and thermal history of the glass. While in clear glasses local variations in heat treatment cannot lead to permanent inhomogeneities in the true sense of the word, this may be doubtlessly the case in two phase glasses. In such two phase glasses local differences in thermal history will strongly influence the formation of nuclei and growth of particles thus causing permanent true inhomogeneities.

Several years ago some inhomogeneous two phase glasses (fluoride and sulfide glasses) were treated with silver and copper stains, giving rise to bluish and reddish patterns respectively. In cooperation with Dr. Weyl some attempts to study these inhomogeneities by means of these stains were made but such procedure was also used for decorative purposes. Many other examples were discussed and prevention of such inhomogeneities by the use of some two and three valent oxides was also discussed.

Staining of Glass, Some Possibilities in the Study of Inhomogeneities. *By W. Weyl, Pennsylvania State College.*

The intensity of the silver stains depends upon the composition of the glass, especially the percentage of sodium oxide, and upon minor constituents such as ferrous oxide, arsenic, antimony and sulfides. This fact can be used to discover inhomogeneities in glass which are due to melting under different furnace atmospheres. Change in the firing condition can be the reason for certain defects, as seed formation and local attack of the refractory by salt water.



BETWEEN SESSIONS WITH THE GLASS DIVISION AT SKYTOP

Photographers, both professional and amateur, were unusually successful this year in shooting the members in unusual and striking poses. All the pictures on this page were the work of E. L. Hettinger, Willson Products Co., to whom The Glass Industry is indebted for many of the pictures that have gone into the making of its interesting year-by-year record of the Glass Division. Note particularly the golfer in the lower row center, where the turf and ball are clearly visible. Additional scenes at Skytop appear on pages 364 and 365.

It is therefore desirable to find means to study those inhomogeneities which arise from different atmospheric fields in the furnace. The method of silver staining seems to do this and preliminary results already show that it can be used to supplement the usual optical methods with and without polarized light. This paper will be published in full in an early number of THE GLASS INDUSTRY.

Homogeneity of Optical Glass. *By W. Fraser and Murray Scott, Bausch and Lomb Optical Co.*

While the two previous papers dealt with what may be termed "gross inhomogeneity," Dr. Fraser's talk swung to the extreme left and covered those cords that one really has to look for in order to see them. Since, in the case of optical glass, a fundamental requirement is homogeneity, a slight departure from a high degree of uniformity in composition cannot be tolerated because of the effect on the performance of the finished instrument.

As striae are due to differences in composition they likewise have different physical properties from the main body of glass, such as expansion and, what is important in the optical industry, different refractive indices. While the index may only vary in the fourth decimal place such a variation can be appreciated when it is compared to the difficulty of definition caused by a warm air current between an observer and a distant object.

Various methods of detecting striae in optical glass were shown and the details described. In addition, a practical demonstration of a projection method as used by Dr. Fraser for the detection of striae was given.

The paper was closed with the showing of an excellent motion picture of an optical glass stirring machine in actual use.

Glass Stones. *By C. L. Thompson, Harbison-Walker Refractories Co.*

After a brief description of the various types of glass stones and the methods used for their examination, Dr. Thompson showed a series of slides illustrating the many different glass stones commonly met in commercial practices. The list included quartz from unmelted batch, tridymite and cristobalite from silica scum and devitrification, devitrite and wollastonite from devitrification, and nephelite, corundum, muelite and kyamite from refractories and for refractory attack.

It was pointed out that since the advent of the new superrefractories it is becoming increasingly more difficult to determine the source of some of the refractory stones.

Progress Report on Activities of A.S.T.M. Committee C. 14 on Glass and Glass Products. *By Louis Navias, General Electric Co.*

The purpose of this progress report was to acquaint the members of the Glass Division with the work that Committee C-14 of the A.S.T.M. is doing on the subject of glass and glass products.

Dr. Navias briefly described the work of each sub-committee and the progress made since the organization of the committee a little over two years ago. A summary of the work follows.

Sub-committee I on Nomenclature has been inactive.

Sub-committee II on Chemical Analysis: a very active group, has prepared a tentative standard method for the chemical analysis of glass sand in addition to developing a new standard soda-lime-silica glass, known as Standard Sample No. 128. Work in progress in this committee concerns both umpire and rapid routine methods for the chemical analysis of soda-lime-silica glasses.

Sub-committee III on Chemical Properties of Glass has been very active on the problem of measuring the chemical durability of glass and has formed several sub-sub-committees to take care of the vast amount of work done before them. A sub-sub-committee dealing with the durability of glass decorating colors has recently been formed.

Sub-committee IV on the Physical Properties of Glass has prepared three tentative methods dealing with the testing of glass containers. These methods include polariscopic testing, pressure testing and shock testing. The work on Tensile Testing has been completed but has not as yet been acted upon.

Sub-committee V on Thermal Properties has been inactive due to lack of a suitable problem on which to work. Dr. Navias called upon the Glass Division to submit such problems as would come under the scope of this group to the committee.

Sub-committee VI on Glass Block and Tile is still working on the accumulation of the existing data and in the near future will become active.

Dr. Navias concluded his remarks by pointing out that the standard methods of test adopted by the A.S.T.M. are not to be considered as permanent standards but merely as starting points. If anyone disagrees with a method or has a better method it is the wish of the committee that they make it known in order that it can be considered.

p_H Determinations in Estimating Durability. *By S. R. Scholes, New York State College of Ceramics at Alfred University.*

The quantity of alkali extracted from glasses in the crushed or powdered form as specified in the tentative durability method of the Glass Division is usually accomplished by titration of the remaining N/50 sulfuric acid with N/50 sodium hydroxide. Because of the fact that the end point of this titration becomes uncertain on account of the high dilution, and the difficulty of getting sharp color change in any suitable indicator, R. F. Doran studied as his Thesis Problem at Alfred the possibility of making use of p_H determinations instead.

After following the established routine for the powder method of attack, Doran removed a small quantity of the solution by pipette and transferred it to the cell of the Beckmann p_H meter. This permitted an estimation of p_H within 0.01. The same procedure having been followed with the original N/50 acid before digestion of the sample, it was then necessary only to subtract this value from the one obtained after digestion to determine the change in p_H as a result of alkali extraction. Reference to logarithm tables and calculations from chemical equivalents then gave the concentration in terms of Na_2O, from which the actual weight of Na_2O could be found.

The usual values of Na_2O extracted from ordinary glasses by the specified method are of the order of 0.04%. Estimation by the p_H method involves an accuracy of about 0.001%.

The particular advantage of this method, aside from the fact that it is rapid and fully as accurate as titration, is that it can be used on successive digestions of the same sample by returning the tested portion to the digestion flask, and thus the effect of time can be found out most conveniently. An interesting difficulty was reported in the variation of p_H traced to the distillation of water from the digestion liquid and condensation on the walls of the flask. Careful rinsing of these droplets into the main liquid by twisting and turning the flask became necessary before the samples were removed by pipette.

Inasmuch as the principal interest of the investigator was in the method, and not in the study of any special glass compositions, no comparative results were reported.

Resistance of Glass Containers to Alcoholic Solutions. *By Frank R. Bacon and O. G. Burch, Owens Illinois Glass Co.*

The work reported in this paper is the result of an attempt to determine the effect of various alcoholic concentrations on the corrosion of glass surfaces and the relationship between accelerated durability tests and the action of alcoholic solutions, such as gin, at normal temperatures.

Four, six and eight ounce bottles of various compositions were filled with alcoholic solutions varying in concentration from 0 to 40 per cent by volume and kept at temperatures of 60°C., 90°C., 126°C. for times varying from 1½ hours to 144 hours. Other tests were made with gin at 70°C. and at room temperature. In the accelerated durability tests water at a temperature of 121°C. was used as the attacking medium.

The extent of attach was measured by determining the amount of soluble and insoluble solids or both and by measuring the time required to form flakes.

Several charts were presented that listed the data obtained in the various tests. It was shown that the resistance of glass to corrosion by alcoholic solutions increases with increasing alcoholic contest, likewise the resistance to flaking increases with increase in alcoholic content although this was not true of all glass compositions.

A comparison of the amount of material extracted from the glass surface by the alcoholic solutions with the tendency to flake indicated that no relationship for all glass compositions exists between the resistance of bottle glasses to the action of distilled water at temperatures betwen 75°C. and 121°C. and the resistance of the same glasses to the action of alcoholic solutions at temperatures from room temperature and 75°C.

The Relations Between Storage and Accelerated Chemical Durability Tests for Several Glass Compositions. *By A. K. Lyle, Hartford Empire Co.*

Mr. Lyle's paper was in the nature of a progress report and dealt with the results obtained to date on a series of ten lots of 16 oz. bottles which are being used in the study of the action of gin and whiskey on glass.

Two general types of test are being made: storage tests, both at room temperature and at 60°C., in which gin is being used as the attacking medium; and accelerated tests in which various attacking mediums and various test temperatures are being used. The data obtained to date is given in Table I.

Some of the more important comparisons were presented in the form of graphs. In the first slide the time to form flakes at 60°C. was plotted against the alkali extracted in 24 hours by O. 02 N acid and water at 95°C. The acid results did not indicate any very close correlation with the flaking time while the water results were somewhat more consistent.

In slide No. 2 the number of days to form flakes at 60°C. were plotted against the alkali extracted in one hour by water and 0.001 N sulphuric acid at 120° C. The relative position of the points especially the acid results, were very much the same as in slide I. The water results give still better agreement than before.

In slide No. 3 the alkali extracted in the 5-hour 130°C. test with water was plotted against the alkali extracted in 14 days at 60°C. No agreement existed as the points were scattered at random.

In slide No. 4 the relation between a storage test at 60°C. and accelerated tests at 120°C. using water, hydrochloric acid and sulphuric acid was shown. Both the acid and water test results fell upon their respective lines with fairly good accuracy and indicated that such a water or acid test would serve to evaluate the glasses in most cases. It was emphasized that in this series of tests the range of chemical attack was of the same order for all the tests.

In slide No. 5 the alkali extracted after 6 months at room temperature was compared with the results obtained in the 95°C.-24-hour test. The acid results showed a definite correlation; the water results showed a vague correlation while the sodium carbonate results gave random plots.

In slide No. 6 the relation between room temperature attach and the 1 hour at 120°C. results were compared. The relationship was almost identical with that shown in slide No. 4.

In summarizing the data and the slides it was pointed out that the degree of correlation depends, to a large extent upon the magnitude of the attack in the accelerated test. If close correlation is desired, the accelerated test should duplicate as nearly as possible the attack produced in service.

Some Observations on the Methods of Analysis Applicable to Solutions Obtained in Tests for Chemical Durability of Glass. *By E. H. Hamilton, Donald Hubbard, and A. N. Finn, National Bureau of Standards.*

In the absence of Mr. Finn this paper was read by Dr. Lundell. The paper consisted of a report on the study of various indicators and was made in order to find an indicator that would be more suitable than methyl red in the titration of the alkalinity of the extracts from both durability tests.

The solutions were prepared by filling a set of bottles with distilled water and heating at 100°C. for 24 hours. After filtering to remove flakes, aliquots were taken and directly titrated with acid using various indicators such as phenolphthalein, bromthymol, phenol red, methyl red, chlorphenol red, paranitro phenol, and methyl orange. Titrations were also made potentiometrically using a glass electrode and a saturated calomel half cell.

The results obtained showed that the direct titration method was not satisfactory due to the influence of carbon dioxide. A series of titrations, using the same indicators, was then made by adding an excess of acid, boiling under pressure to remove carbon dioxide and then titrating with 0.02N NaOH. It was found that this method gave results that were more definite and reliable than those obtained by direct titration.

It was suggested that the back titration method using either bromthymol blue or phenol red indicators be given serious consideration as a standard procedure especially during this cooperative period when several laboratories are trying to compare results.

Chemical Durability Requirements of Pharmaceutical Containers. *By E. B. Carter, Abbott Laboratories.*

This paper is given in full on page 371 of this issue.

A brief report of the round table discussion on Chemical Analysis, led by Dr. G. E. F. Lundell, will be found on page 372.

TABLE I. SOME RELATIONS BETWEEN STORAGE AND ACCELERATED CHEMICAL DURABILITY TESTS
CHEMICAL DURABILITY DATA (A. K. Lyle).

	Glass Number	1	2	3	4	5	6	7	8	9	10	*Units*
Storage Tests	Alkalinity after 14 da. at 60°C.	2.5	2.5	2.5	4.8	6.4	8.0	6.4	9.0	12.0	15.2	mg.NaOH/1
	Alkalinity after 3 mo. at 60°C.	7.2	6.4	8.0	31.2	40.0	28.8	22.4	31.2	40.8	42.4	"
	Alkalinity aft. 6 mo. at room temp.	2.6	2.9	3.0	3.0	5.1	6.8	6.5	5.6	8.6	10.3F	"
	pH after 14 da. at 60°C.	7.5	7.1	7.1	7.3	7.3	7.5	8.8	8.3	9.0	9.5	.....
	pH after 3 mo. at 60°C.	8.0	7.8	7.4	...	9.3	9.5	9.3	10.3	9.6	10.0	.....
	Days to form flakes at 60°C.	42	...	...	28	24	27	23	21	34	6	.....
	pH when flakes formed	7.2	...	...	7.5	8.2	8.7	9.4	8.7	9.4	8.8	.....
	Alkalinity when flakes formed	4.0	...	...	6.4	8.0	9.0	10.4	16.8	18.4	7.2	mg.NaOH/1
Accelerated Tests	Grain test 95°C—4 hrs. .02N H_2SO_4	...	.030	.026	.026	...	.064	.063	...	.079	...	% Na_2O
	24 hrs. 95°C. .02N H_2SO_4	5	6	7	7	13	17	19	...	22	19	mg.NaOH/1
	24 hrs. 95°C. Water	13	7	7	17	23	21	23	...	31	53	"
	24 hrs. 95°C. .001N Na_2CO_3	50	63	18	59	51	34	35	...	40	97	"
	1 hr. 120°C. .001N H_2SO_4	4	4	4	6	9	12	13	...	17	14	"
	1 hr. 120°C. .001N HCl	3	3	3	5	8	11	12	...	16	9	"
	1 hr. 120°C. Water	4	4	5	12	12	14	15	16	19	25	"
	5 hrs. 130°C. Water	65	17	18	98	65	44	49	...	50	114	"

F = Flakes in 6 months

HOLLISTER JOINS L-O-F

The appointment of Clay H. Hollister, Jr., market analyst, as distributors' sales consultant to the Libbey-Owens-Ford Glass Co., has been announced by G. P. MacNichol, Jr., vice-president in charge of sales. Mr. Hollister will act as consultant in merchandising and sales policy. Creation of this new department by L-O-F is in line with its policy of extending every possible assistance to dealers in building up a greater market for glass products.

PITTSBURGH CORNING ANNOUNCES NEW ARCHITECTURAL GLASS

An architectural glass that can be formed into entire walls has been developed by the Pittsburgh Corning Corporation and is being produced in panels having a surface area as large as four feet by four feet. The new material permits the passage of light and at the same time has a moulded or bas-relief surface that is decorative.

The new architectural glass is cast from permanent moulds, making possible the production of any number of identical patterns. Pittsburgh Corning is also producing special patterns of sculptured architectural glass made to specifications of architects. In the latter case plaster moulds are reproduced and so faithful is the reproduction that the finished glass will show marks of the sculptor's tools and the texture he has applied.

Both the sculptured and the standard design architectural glass can be finished in a variety of ways to give unusual effects. The reverse side can be matted, mirrored, polished, or "sand fused." Other effects can be obtained by the use of a "Sea Water" glass, a light greenish glass whose lustre becomes more rich as the thickness of the glass increases.

In addition to such more common uses as partitions, store fronts, doors, and display cases, architectural glass is being developed for illumination around full length mirrors, bars, stair risers, mausoleums, and filling stations. Sculptured glass is being used for wall murals, building lobbies, and decorative windows. Another important use is for the transoms over entrance doors of large buildings.

Office view showing new Pittsburgh Corning architectural panels in wall at left and sculptured glass at right.

G. C. A. FALL MEETING

The Board of Directors of the Glass Container Association has announced that the fall meeting of that Association will be held at the Westchester Country Club, Rye, N. Y., on Tuesday and Wednesday, October 24th and 25th. The Board of Directors will hold its meeting on Monday, October 23rd. The Westchester Country Club compares favorably in size with the Greenbrier Hotel at White Sulphur Springs and offers two golf courses and other facilities that go with a well organized country club. Rye is only 45 minutes from New York City and the advantages of that city are also readily available.

REVIEW

Fonds National de la Recherche Scientifique et L'Industrie. P. Beghin, Brussels. pp. 408. National Foundation for Scientific Research and Industry.

Thus summary of the activities of the Belgian State in the field of Scientific Research as applied to industrial problems, is intended in part as a reply to certain criticisms levelled against the Foundation for its apparent interest in overseas exploration in its early years, at the expense of home industries. Dr. Pierre Beghin, Secretary of the Foundation, here summarizes the activities of numerous research workers who have been subsidized by the Foundation to investigate matters of very practical importance to Belgian industry. Since the Belgian glass industry is unquestionably one of the nation's great assets, a chapter or two is devoted to it, and the subject matter is of no little interest to American manufacturers also, particularly those sections relating to the scientific basis of the Fourcault operations for making sheet glass. With very little change, his observations are equally applicable to all other methods of making sheet glass, so long as they are mechanical, and not hand-and-mouth operations.

The fact that in this country flat glass manufacturers have, for the most part, no adequate knowledge of the temperature-viscosity curves of their glass, and no adequate knowledge of the devitrification properties of glasses within the range of commercial practicability, has produced several awkward results. Improvements in drawing results have been obtained on the basis of Japanese experience, and improvements in devitrification behavior from European experience. However, there is reason to believe no one has yet obtained all the improvement possible in these respects and simultaneously an improvement in chemical durability. The Belgian experiments recorded by Dr. Beghin seem to be the most complete of which we have notification. Incidentally, this information is also needed in the field of special glasses, whenever these lend themselves to mechanized operation, and not necessarily in sheet form at that.

Another section deals with the constitution and behavior of colored glasses, particularly the Cadmium Sulphide glasses, with some reference also to other coloring agents, including elemental silver and copper.

It is good to see the spirit of scientific glass technology taking root in Belgium, though we feel some regret that with all its wealth and with all the stake it has in the glass industry, the United States still leave it to Europeans to show them the way.—F. W. P.

INSTALLS NEW DUAL-PURPOSE LEHR

At its Hartford City plant, the Johnston Glass Co. is now operating a special continuous combination lehr which can be used for either annealing or decorating, as desired.

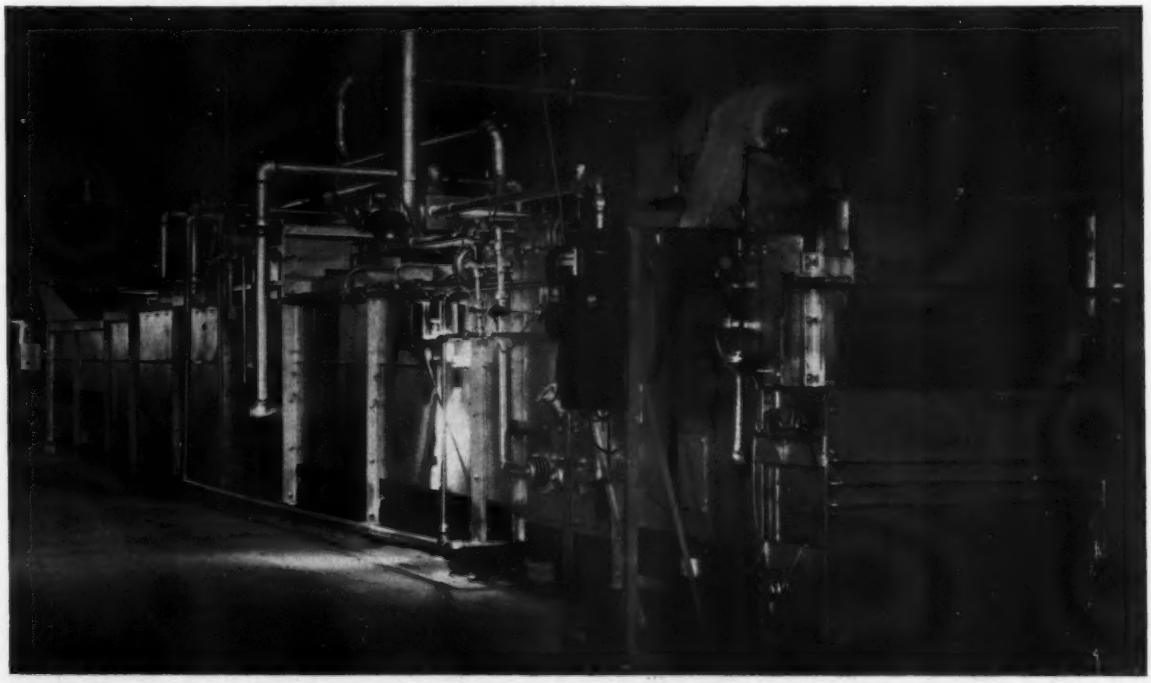
Operations at the Johnston Glass Co., Hartford City, Indiana, include both processing and decorating of flat glass sheets and panels of various sizes. The processing work consists of bending and convexing with special heating ovens and forming equipment; the decorating operations are performed on flat or shaped glass panels utilizing both silk screen and spray processes. Johnston Glass formerly manufactured its own glass by the blown cylinder method, but these operations were discontinued many years ago and the company now uses sheet glass made by other glass manufacturers, both single and double strength.

Processed glass products include bent glass panels, up to 40 in. by 72 in., for show cases, greenhouses, furniture, etc., and convex glasses for picture frames, headlights, mirrors, etc., ranging from 2 in. to 30 in. in diameter. Among the decorated products are found radio dials, gasoline pump signs, both flat and convex, and miscellaneous flat signs. The finishing of this variety of products requires equipment for both annealing and color-firing, but the problem is complicated by the fact that the amount of each kind of work in production at any given time varies widely. In other words, the plant may at one time be occupied almost entirely with orders for bent glass products and at other times the proportion of decorating work may be very high. The installation of single-purpose lehr equipment for both annealing and decorating would, of course, be very expensive both in first cost and in operation.

These special conditions led to consideration of a lehr that could be used for either annealing or decorating, as required, and the idea was first tried out by adding a set of radiant tubes to a Surface Combustion annealing lehr already in service. This experiment turned out to be a commercial and engineering success and Johnston Glass has now installed a new continuous combination lehr, based on the results obtained with the other. The new lehr was designed, built and installed by the Surface Combustion Co., Toledo, Ohio.

Like ordinary lehrs, this dual-purpose equipment includes an insulated tunnel with wire-mesh belt and drive, but in other respects it differs widely since it has two separate and independent firing systems each of which is subject to automatic temperature control. For annealing bent or convex glass charged hot, a direct-firing heating system is located near the charging end of the lehr; and for firing decorated ware charged cold, a radiant-tube heating system is located in an intermediate section of the tunnel. Fig 1 is a view of the new combination lehr from the charging end, the radiant tubes being located in the enlarged section about half way down the enclosed tunnel.

The over-all length of the lehr from center to center of end rolls is 75 ft., including an enclosed tunnel 63 ft.



New continuous lehr, combining annealing and decorating, recently installed by Surface Combustion Co. at Hartford City, Indiana, as seen from the charging end. Overall length is 75 feet.

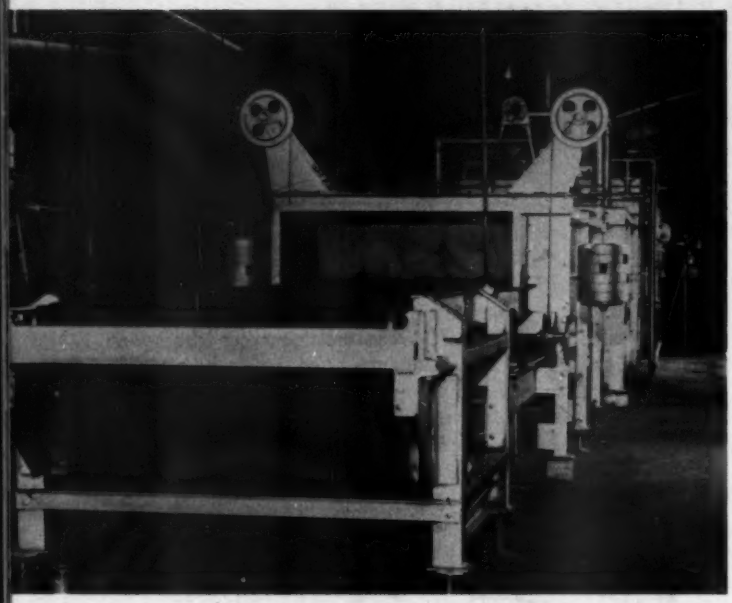


Fig. 2. Looking toward the discharge end, showing the 12-foot open section and the belt take-up counterweights.

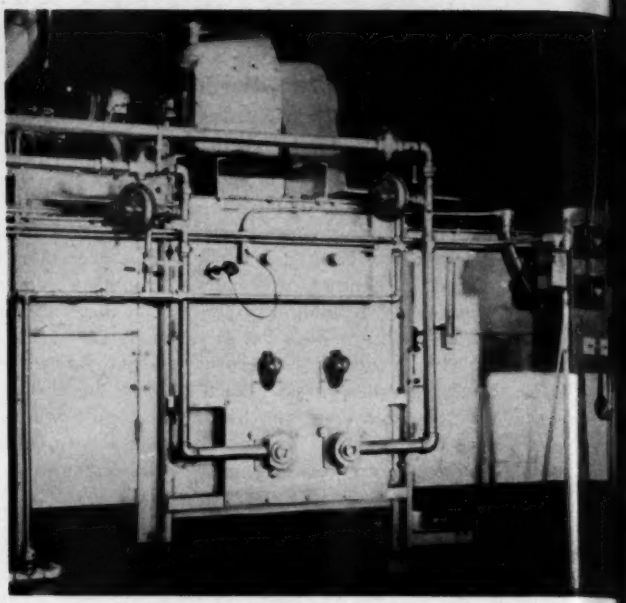


Fig. 4. Annealing section, showing 2 of 4 direct firing burners and air piping, gas regulators and inspirators, and instrument p

long and a discharge table 12 ft. long, the latter being shown in Fig. 2. The clear height from the top of the belt to the bottom of the tunnel roof supports is 16 in. and the lehr is enclosed in a structural steel casing. A lift-type door is provided at the charging end and is equipped with manually operated height adjustment. Adjustable asbestos fabric curtains are provided at one point in the cooling zone and at the discharge end of the tunnel and clean-out and inspection doors are located at intervals in the side walls.

The two heating zones, for annealing and decorating respectively, occupy the first 42 ft. of tunnel at the charging end and are lined with 9 in. of insulating brick in the side walls, 7½ in. of insulating brick on the bottom and 6 in. of glass wool blanket on the roof. The remainder of the tunnel is lined with various thicknesses of these materials, as required by the cooling curve. Adjustable vents in the tunnel roof beyond the heating zones can be used to control the cooling gradient.

The carbon-steel, wire-mesh conveyor belt is of the balanced spiral type, the upper strand being carried through the tunnel on idler rollers spaced on 12-in. centers and the lower strand supported by ball-bearing rollers located about 6 ft. apart. The width of the conveyor belt is 48 inches. The belt drive is located at the discharge end of the lehr and is shown in Fig. 3. The large driving roller is mounted in self-aligning, ball-bearing pillow blocks and is covered with a replaceable rubber friction facing. The driving mechanism includes a ¾-hp. motor direct-connected to a Reeves variable-speed unit, a Texrope drive from this unit to an enclosed gear reduction unit, and a final chain drive to the large driving roller. After leaving the driving roller the belt passes over an idler and then back to a take-up roller which compensates for slack caused by heating of the belt. Fig. 2 shows the take-up counterweights and the cables passing over sheaves at the top of the lehr. Belt speeds can be varied from 30 to 180 ft. per hour.

For supplying heat during the annealing operation the lehr is equipped with four direct-firing burners, two on each side near the charging end, each being furnished with individual, automatically proportioning inspirators. Combustion air is supplied at 16 oz. pressure and natural gas is used at a regulated pressure of 6 in. In Fig. 4 the air and gas lines leading to the burners can be seen, together with the diaphragm-type gas-pressure regulators at the inspirators. The burners fire into four ducts or flues in the bottom of the tunnel, two of which lead toward the front and the others toward the discharging end of the lehr. Openings in the roofs of the flues allow the combustion products to pass into the tunnel. Through openings in the top of the heating zone the hot gases are withdrawn by a motor-driven recirculating fan and are forced down through ducts in the side walls leading to

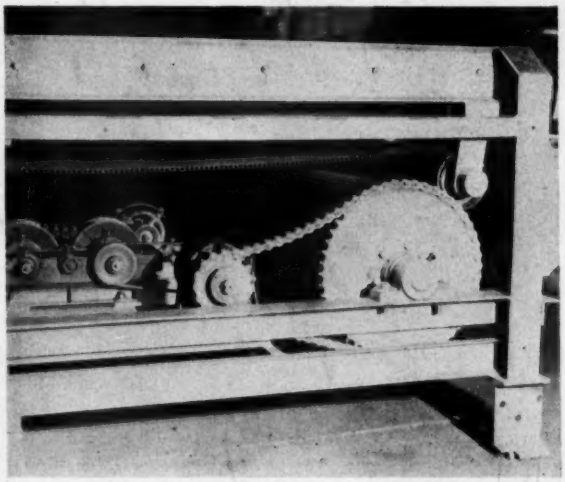


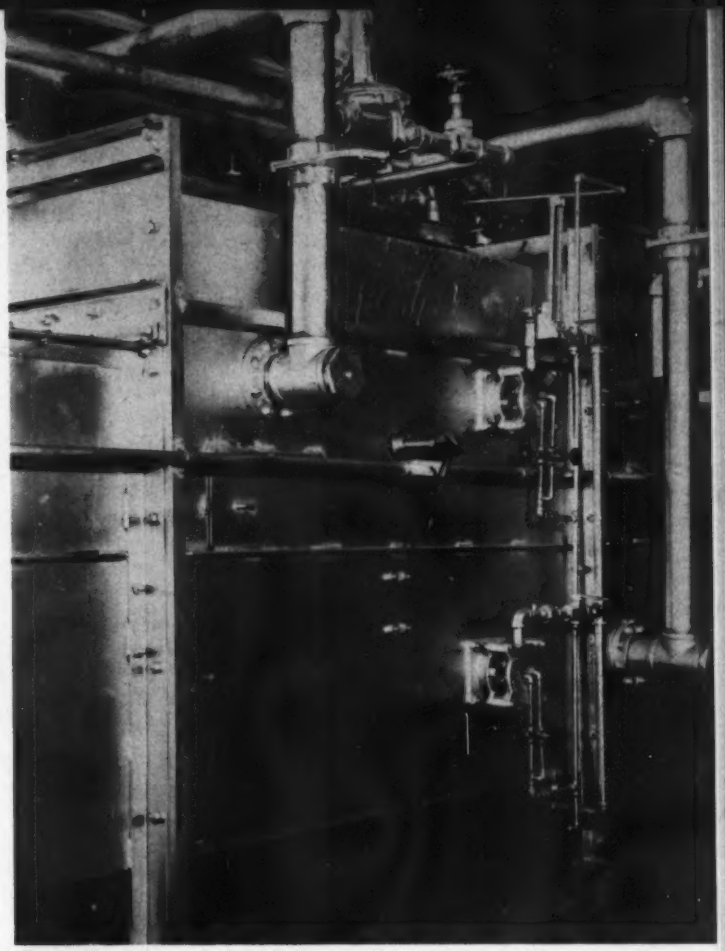
Fig. 3 Lehr belt drive, including motor, Reeves variable speed unit, Texrope, gear speed reducer, chain and sprockets, and rubber covered driving roller. Belt speeds from 30 to 180 ft. per hour.

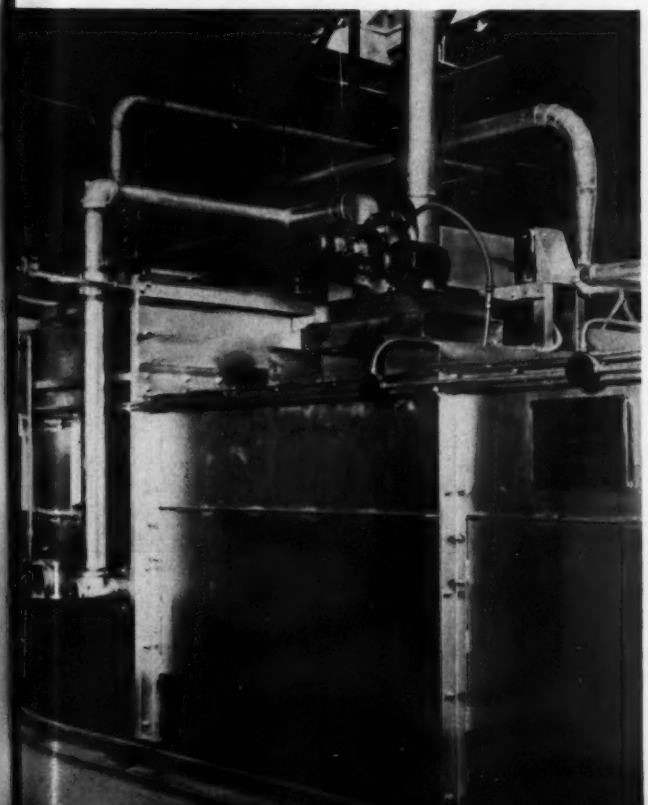
each burner. In this way the gases give up heat to the glass and are then reheated by being recirculated past the burners.

Piping and burners for the radiant tubes in the decorating zone are shown in Figs. 5 and 6, the views being taken from opposite sides of the lehr and looking toward the discharge end. There are three sets of radiant tubes, one being located above the belt and the others below. The upper tube is of the so-called M-shape with the burner at one end and the outlet at the other. In the upper section of the casing in Fig. 6, the burner can be seen at the right and the exhaust tube at the left. Likewise, the burner for one of the lower tubes can be seen in the same illustration with the exhaust pipe beyond. The burner for the other bottom tube is located on the other side of the lehr and appears with its accompanying exhaust pipe in Fig. 5. The radiant tube located at the bottom and extending toward the discharge end of the lehr is the longest and has several exhaust pipes. All of the exhaust pipes are fitted with slide gates by means of which the amount of hot gas withdrawn from the radiant tubes at given points may be controlled, thus providing for adjustment of the temperature gradient when decorating.

The exhaust pipes from the radiant tubes lead to a header which is in turn connected to the inlet of a high-temperature fan which can be seen on top of the lehr casing in Fig. 5. The exhaust from the fan passes out of the building through a long stack.

Provision is made for automatic temperature control in the proper heating zone for either annealing or decorating. The indicating controller is mounted in the upper right corner of the instrument panel in Fig. 4 and can be conected to the thermocouple and control valve in either zone by means of a double-throw switch. The amount of gas used in the burners in the annealing zone depends on the amount of 16-oz. air passing to the inspirators, so in this case the controller actuates a motor-operated valve in the air line. On the other hand, the amount of heat supplied by the radiant tubes in the decorating zone depends on the amount of suction applied to the tubes. When decorating work is being handled, therefore, the control instrument actuates a motor-operated gate or butterfly valve in the suction line leading to the fan.





(Lower left) Fig. 5. Decoration zone, showing the burner and exhaust pipe for one of the three radiant tubes. Suction fan for the radiant tubes can be seen above the lehr casing. (Above) Fig. 6. Decoration section from the opposite side. Here can be seen the burners and exhaust pipes for the other two radiant tubes, one above and the other below.

Temperatures at other points in the lehr may be indicated by connecting the instrument to a six-point rotary switch through a single-throw knife switch. The rotary and knife switches can be seen at the bottom of the instrument panel in Fig. 4. As the rotary switch is turned to the various points, the respective temperatures are indicated on the instrument above.

Starting and stopping of the recirculating fan for annealing and the exhaust fan for decorating are controlled from push-button stations located on the side of the lehr, these controls being interlocked so that both fans cannot be operated simultaneously. The routine for changing the lehr over from annealing to decorating, or vice versa, is comparatively simple: One fan motor is stopped and the other is started; the controller connections are reversed through the double-throw switch; and the burners in the desired zone are lighted. As soon as the temperature in the operating zone comes up to the required amount, the lehr is ready for the new operation. In the annealing zone the maximum annealing temperature is 1,050 deg. F. and a maximum firing temperature if 1,150 deg. F. is carried in the decorating zone.

PRODUCTION FIGURES FOR THE GLASS INDUSTRY DURING AUGUST

Window Glass: During August 1939 the production of window glass was 867,452 boxes which represents 53.4 per cent of industry capacity. As compared with this, August 1939 production was 433,877 boxes, representing 26.7 per cent of industry capacity.

Plate Glass: The total production of polished plate glass by member companies of the Plate Glass Manufacturers of America during August,1939, was 10,450,189 sq. ft. as compared to 6,212,209 sq. ft. produced in the preceding month, July, 1939, and 7,676,078 sq. ft. produced in August, 1938.

Glass Containers: Production of glass containers during the month of August, 1939, was 4,802,070 gross, bringing the 1939 total to 33,732,091 gross. Shipments during August were 4,753,335 gross, bringing the 1939 total to 32,704,096.

RIEMAN JOINS BALL BROTHERS

G. Fred Rieman of Connellsville, Pa., has resigned as vice-president of the Anchor Hocking Glass Corporation of Lancaster, Ohio, to assume a general executive position with Ball Brothers Co. of Muncie, Ind. Mr. Rieman came to Connellsville in May 1919 when the Anchor Cap & Closure Corporation of New York City formed the Capstan Glass Co. and located its factory in Connellsville. In 1920, he became president and general manager of the new company and in 1934, when the parent company purchased the Salem Glass Works, he was made general manager of the glass division in charge of both plants. At the time of the merger of the Anchor Cap Corporation with the Hocking Glass Co., resulting in the present Anchor Hocking Glass Corporation, Mr. Rieman became a vice-president of the new corporation. In his new affiliation, Mr. Rieman will serve in a general executive capacity with the title of assistant vice-president. His office will shortly be located in Muncie, Ind.

CONCERNING EXPORTS AND IMPORTS

With many of the European glass producing countries engaged in war and others finding their export markets restricted due to curtailed shipping facilities, the Bureau of Foreign and Domestic Commerce anticipates a sharp increase in foreign demand for glassware of American manufacture, particularly in the South American countries. The progress American manufacturers have made in the past few years in producing quality ware at moderate prices has vastly increased its salability abroad, and our manufacturers have an unparalleled opportunity to keep and hold new markets. H. K. McCoy, head of the Specialties Division, recommends that those already engaged in foreign commerce or who contemplate doing so, keep in close touch with his office and inform themselves of the shifts in foreign national policy which are occurring with great rapidity.

In this connection it is interesting to note that of the six leading countries exporting glassware to the United States, five are at war, and the sixth (Belgium) is surrounded by belligerents. The opposite prevails with American exports: Of the six most important buyers of our glass, none are located in Europe and only Canada (our most important buyer) and Australia (sixth place) are at war.

DEPARTMENT OF COMMERCE PROMOTES AMERICAN MADE GLASSWARE

View of the main lobby of the great Commerce building at Washington as it looked during the recent summer months. Thousands of visitors to the Department on entering the building have seen these display cases showing the finest specimens of many types of ware and have read the sign put there by the American Glassware Association.

CHEMICAL DURABILITY REQUIREMENTS OF PHARMACEUTICAL CONTAINERS

I quote from an old paper by W. R. Lester, your program chairman, for a sort of a preliminary statement of the basic problem in which you as manufacturers of glass containers and we as a class of users of the containers find a common ground for discussion. Part of his opening paragraph* states:

"At the present time a good many pharmaceutical manufacturers are using or adopting so called 'solubility tests' for the purpose of preventing the use of glass unsuitable in composition as containers for certain pharmaceuticals. It is unfortunate that the originators of some of these tests were not more conversant with the physical properties of glass, especially in regards to the action of water and other liquids upon glass surfaces."

We agree with Mr. Lester that it is unfortunate that the pharmaceutical industry which originated these tests were "not more conversant with the physical properties of glass," and I must admit for myself that it was not more than two years ago that I had the privilege of meeting Mr. O. G. Burch of the Owens-Illinois Company, and learning from him something of the mechanism of this destruction of glass by solutions. My conversation with Mr. Burch was preliminary to a small meeting, which likewise took place two years ago, of representatives of a few of the glass container manufacturers with the Chairman of the National Formulary Revision Committee. The group discussed glass used as containers for a particular type of product: the large volume intravenous solutions. To my knowledge, this was the first and the only meeting of representatives of the two industries. Let us hope that it will not be the last.

In developing the so-called "solubility tests" for glass, we can admit a certain ignorance of the physical properties of glass; but as we proceed you may agree that these tests which have been proposed and used, serve to give us some idea of the suitability of different types of glass for our products.

In general, the durability requirements of pharmaceutical containers are very simple: we want glass containers that will not bring about any undesirable changes in the nature or appearance of the products which we put into them. Actually, the problem may become more complex because of the increasing variety of products which we desire to package in glass.

In the paper to which we have referred, Mr. Lester has pointed out the very marked effect of increased temperature on the decomposition of glass by water. If all pharmaceutical products were simply the old classic hydro alcoholic solutions of common drugs, filled into bottles and kept always within the limits of summer and winter temperatures, neither you nor we would have to worry much about chemical durability. But the old order changes. Not only time, but medicine, marches on. New types of medicaments are the order of the day, and while we logically turn to the glass container, new requirements in the durability of glass must be met.

New solvents are being used. The maintenance of a constant hydrogen-ion concentration becomes imperative, and in many instances the medicaments must be sterilized at high temperature after being sealed within the containers. Some of the same problems no doubt are found in the food packing industry.

One of the oldest glass problems of the pharmaceutical manufacturer has been the bottles for Milk of Magnesia. This problem has been largely solved by buffering the product. Likewise with other products, we have buffered either on the acid or alkaline side and have stabilized our preparation against the decomposition of the glass and the resulting decomposition of the product. We still need an inexpensive glass which, at room temperature, will not be decomposed by aqueous solutions at p_H 10 to 11. Am I asking too much?

To many of you, the subject of ampoule glass will be of but passing interest. To the pharmaceutical industry it presented a new problem when it was found that the aqueous solutions had to be sealed in glass and then sterilized in the autoclave in steam at 120°C.

The problem became even more serious when it was found necessary to sterilize pure distilled water in glass ampoules. Then we learned what you knew already, that it was much more difficult to obtain a glass ampoule that would not be attacked by distilled water than it was to get one not attacked by solutions of medicinal chemicals. Those who used the imported Jena glass ampoules had to sterilize ampoules of distilled water by the intermittent method of heating to 85° C. for a half hour on three successive days; otherwise their distilled water ampoules showed flakes of glass. The difficulty was solved for some of us by the development of a new resistant tubing by the old Libby Glass Company out of their experience in making gauge glasses.

The test for "ampoule glass" given in the National Formulary VI has been justly criticized as permitting too much soluble alkalinity. The fact is that at the time the VI Revision was printed, the test had to be made very liberal in order to pass many of the Jena glass ampoules which some pharmaceutical houses were using. With the development of the N.C.51 ampoule glass by the Kimble Glass Company, the problem of the manufacturer of ampoule solutions is practically solved, and the N.F. test for ampoule glass will now be made much more stringent.

Later came a new need, a need for sterile solutions for intravenous use in large containers holding a liter or more. Like the ampoule solutions, these needed to be sterilized at high temperature in the sealed containers. These solutions are ready to use, and therefore more dilute than the average ampoule solution, and hence more destructive on the glass.

Boro-silicate glass was satisfactory, but too expensive. It is true that for hospitals located near the manufacturing laboratory, the container could be returned and reused several times. But the larger hospitals nearer to the large manufacturing centers are not the only users. Besides, many of them are well equipped to make and sterilize their own solutions. The greatest need is from the many small hospitals located throughout the entire country.

There is also an appreciable need for these solutions

in the home, in communities where there are no hospitals. Hence, the primary requirement is for a relatively cheap container which makes but one trip from the laboratory to the bedside. This requirement has been met in a fairly satisfactory manner by using certain soda-lime-silica glasses and treating the inside surface with hot acid. Just what the acid treatment does to the surface of the glass, you men know better than I; but it does enable the manufacturer to utilize an inexpensive glass, and by carefully controlling his sterilization, put out large volumes of intravenous solutions that are not appreciably affected by the glass, and at a price sufficiently low to make them practical for immediate use for every doctor throughout the country and even on shipboard.

In testing the glass of such containers, it is obvious that the manufacturer will not resort to tests made on the crushed glass. Here again the test will be one to determine the action of water on the inner surface of the container.

Many biological products which are filled cold in the glass containers and are stored at refrigerator temperatures most of the time, and never heated above summer temperatures, are very susceptible to the action of small amounts of alkali. Special glasses are readily available for the smaller packages, but these are certain biterinary biologics which must be filled into bottles holding up to 500 cc., and the selling price will not carry a high container cost. Here again, surface treatment enables the glass to withstand the test required by the Bureau of Animal Industry. This test is also a practical test. It is not made on the crushed sample but is made on the inner surface of the bottle. You are no doubt familiar with the details of the B.A.I. test.

In the pharmaceutical business, the container should logically make but one trip to the consumer. Hence, it must be relatively inexpensive. This requirement denitely limits the glass manufacturer. In many situations the requirement may be met by surface treatment. Since such a treatment affects only the surface, a test made on the crushed glass cannot be a measure of the practical durability of the container.

In our limited experience, the soda-lime-silica glass with the lowest soluble alkalinity when tested on the crushed sample will give the lowest soluble alkalinity when the test is applied to the inner surface, after the surface has been treated with hot acid.

So long as our most important problems are concerned with the packaging of products with a hydrogen-ion concentration on the acid side, it appears that a test made on the inner surface of the bottle is most indicative of its durability. The B.A.I. test is official so far as some veterinary biologics are concerned and a new test is proposed by the National Formulary for containers of large volumes of intravenous solutions (see Bulletin of National Formulary Committee, *Vol. VII*, 160-161, Feb., 1939). Until we take up the problem of containers for products more or less alkaline in reaction, of which there are not so many, either of these official tests should be indicative of the practical durability of the glass. Both of them are measures of the durability of the inner surface, but the proposed test of the National Formulary Revision Committee is a more refined test. It is a more exacting test and yet the standard is attainable. In my opinion, it is a test which could be tentatively adopted by the pharmaceutical industry for containers for many of the pharmaceutical products which may not be packaged in the untreated, common glass. There will always be some products which will require more resistant glass than may be obtained by the acid treatment of the usual soda-lime-silica glass.

You may have lost some beer bottle business to the can manufacturers, but there appears to be no substitute for the glass container for most pharmaceutical products. The manufacture and distribution of still finer pharmaceuticals in the future may require finer developments in the composition of glass which will adequately preserve these new products.

*"Glass Durability." By W. R. Lester, *The Drug & Cosmetic Industry*, March, 1932.

DISCUSSION ON CHEMICAL ANALYSIS

The success of the round-table discussion on chemical analysis held last year at the old Point Comfort meeting was such that a similar session was scheduled for this meeting. That there is a real need for such sessions was shown by the attendance of nearly fifty and included both glass chemists and others having an interest in this work.

In developing the discussion Dr. Lundell first outlined the recently completed A.S.T.M. C-14 tentative method for the analysis of glass sand. Numerous questions were then raised by the group regarding the procedures and other details. These were answered by Dr. Lundell and other members of the group. This informal procedure was carried throughout the session and allowed everyone present to express his opinions.

Other subjects covered during the discussion included a report on the results obtained by cooperative work on the colorimetric determination of iron in glass sands and a report on the recently proposed rapid routine methods for the chemical analysis of glass. This latter report dealt with the so-called unit methods of analysis and included data on the 8-hydroxquinolate methods for magnesia and alumina, the triple acetate method for sodium, the Hicks method for potassium and the partition method boron.

This work on the chemical analysis of both glass and glass making materials is to be continued and progress reports will be given at future meetings.

TO HOLD SYMPOSIUM ON TEMPERATURE

On November 2 to 4th, the American Institute of Physics will hold a symposium on the measurement and control of temperature in science and industry at the Hotel Pennsylvania, New York, with the cooperation of the National Bureau of Standards, the National Research Council and the officers and committees of many technical societies.

The program is in charge of representative committees of authorities in various fields, who have arranged for a program of 100 or more papers. All interested persons active in science or engineering are cordially invited to attend the sessions and take part in the discussions. A complete program containing full abstracts of the papers to be presented may be obtained by writing the American Institute of Physics, 175 Fifth Ave., N. Y.

EARLY GLASS-MAKING IN VIRGINIA

By WALTER J. SPARKS

The first glass furnace in America was erected under the direction of Captain John Smith in 1608. As a traveler and seafaring man he would be often in Southampton and have ample opportunity of becoming familiar with the glass furnaces of Surrey-Sussex and those which by his day had penetrated into Hampshire. He had wide knowledge of both men and things and for about four hundred years glass had been made in England by French, Italians and other foreign glass workers. In Virginia he had charge of the four Poles who made glass and of four Dutchmen who were probably primarily interested in construction. Smith certainly could superintend the building of the furnace and the beginning of the industry and that very capably.

At this period there was in England an insistent demand for the manufacture of iron. This new industry needed also a great quantity of wood for fuel and the supply was not enough for both so every possible obstacle was put in the way of the glass-makers; forcing their migration to Hampshire, Kent, Gloucestershire and on to Bristol, Newcastle and Stourbridge. Many of the smaller companies went out of business. The far-seeing John Smith knew the advantage of transporting some of these glass-men to America, where fuel was so plentiful, and the great commercial value to the Colony of importing glassware to England. It would help the distressed workers; relieve England and establish an important industry in America.

The four Polish glass-makers selected for the experiment were such clever, versatile men (as is proved by their later history) that it is possible they may have been personally chosen as men of fine character and unusual ability. They could not only make glass but were good chemists who knew the secrets of making tar, pitch and soda. They could also manufacture their own glass pots. These fine Poles were certainly unfortunate in having as co-workers the four Dutchmen who turned out a constant menace to the colony and within a few years suffered death for their infamous conspiracies.

The furnace built under the superintendence of John Smith was doubtless the oblong type and a duplicate of the French style used in Surrey-Sussex. They made a batch of glass and had it in readiness to send to England upon the return of Captain Newport's ship. Thus glass became the first manufactured as well as the first exported goods of North America.

The success of this glass venture made an impression upon the mother country and John Smith was urged to employ more glassblowers. He discouraged this being done immediately, urging that the settlers needed food more than they needed glass and that therefore the London Company send more agricultural laborers before they sent more glass-men.

A statement in "Wealden Glass" by S. E. Winbolt intimates that James I was as anxious as the people to protect the forests from destruction and that the "Industry in Sussex received a serious seback in 1615 by a proclamation of the king prohibiting wood fuel for furnaces." He also prohibited the importation of foreign glass. "Prohibiting" became a favorite trick with James. Later he prohibited the importing of tobacco from Spain in order to make England the exclusive market for Virginia tobacco from which he derived a profit. Similarly he expected to profit from Virginia-made glass. But at the same time that England was an open market for this glass, there developed such urgent need and demand for pitch and tar both in the Colony and in England that the Poles were kept very busy providing both. So highly were their services esteemed that in 1617 the London Company conferred upon them the high honor of citizenship. During these early years of calamity and death in Virginia with so slow an increase in population, there would not be a great demand for glass and an occasional few days at the furnace would provide the window glass and bottles required by the colony. All thought of export seems to have died out for the present.

Some samples of this early glass

I have been so fortunate as to unearth a few interesting specimens of the work of these Poles, from or near to early foundations built of ballast stones from English ships that arrived at Jamestown prior to the advent of Governor Sir Thomas Gates and Sir Thomas Dale. During the period of Gates' administration there were very few people living in Jamestown. When these two great organizers left the country there were but fifty there in residence while in Dale's new settlement in Bermuda Hundred there were five hundred. Fragments of early glass would be very few and those I have make a very small but rare collection.

I have bases of bottles which resemble one in the Guildford Museum, England, in their exhibit of "Chedding-

Early 17th Century bottle attributed to first Jamestown, Va., glass house (1608-1730).

fold Bases, 13th to 15th Centuries." I have also three bottle necks of this first glass made in Virginia. About its identity there can be no mistake, because it is a soda glass. Light green in color it is distinctly different from the glass made later by the Italians. It shows degeneration, some pits in the necks nearly perforating the glass.

I showed one of these bottle necks to Mr. Ed. Barry, an official of the Libby Company and Works Manager there for thirty years and associate of the most famous glass experts of his generation. Mr. Barry was most interested and immediately noted the evidence of high per cent of soda in the glass revealed by this degeneration. This comment was very satisfactory because the fact that the Poles made soda glass is made evident by a letter written to England in 1610. The writer says:

"We have a little house with abundance of salsodiac for making glass."

Students of prehistoric glass say that very probably more fragments of Oriental glass would be discovered but for the fact that much glass so high in soda content may have disintegrated completely through long years of burial.

We note with great interest that in Mr. Winbolt's book he says that from the 13th to the 16th century the glass-makers in England used potash. The soda period began in the time of Jean Carre who received a license to manufacture glass in 1567 and who believed that soda made a much better glass than potash.

From a chart furnished by Dr. Donald E. Sharp I find that the ancient Egyptians made a glass high in soda with a small percentage of potash. In Virginia this order was reversed. Soda was used in the first period, from 1608 to 1620, by the Polish glass-makers. From 1622 to the end of the Colonial period potash was used, decreasing from the high of 18 per cent to the low of 1.90 per cent at the end of the 18th century.

In the 17th and 18th centuries there was sometimes a small amount of soda in the batch in addition to the potash. The sample that contained 18 per cent potash had 1.08 per cent soda.

The potash was probably used because in clearing the forests it was more easily obtained.

I have found no later record of the Polish glass-makers than that of 1617, already quoted. They had then become famous both in Virginia and in England for their ability and faithfulness in providing the much esteemed and necessary products; pitch and tar to supply the ship-building industry. Their reward, the coveted honor of citizenship.

Another glass plant is started

In 1621 the London Company received an urgent request from Virginia for "Beads and suchlike toys" to use in trade with the Indians for corn and other commodities. To meet this need a joint stock company was formed which sent to Virginia five Italian glass-makers with their families and servants, to make beads for trade with the Indians.

Captain Norton was appointed to "Direct the Adventure" and it was provided that in case of his death, Mr. George Sandys, brother of Sir Edwin and newly appointed treasurer of the colony should take charge of the glass industry.

From "Wealdon Glass" we learn that, at this time, in the home land there was an agitation against foreigners and a demand that Englishmen be taught to make glass. This explains why a boy was added to the glass-makers' staff in Virginia. The boy is described as "Old Shepherd his Son. (The son of Old Shepherd.)

The Italians were engaged to make "Drynking, Round and Beads." They were also given the sole right to make soda. The contract between the London Company and the joint stock company was for seven years and of course this contract released the Poles from the responsibility of making glass and soda.

The beads made were to become the "Actual coinage of the Country." Therefore their production must be "Stinted" that their value should not decrease. From time to time the authorities must decide how much of this glass coinage should be issued for the Indian trade and that number of beads made and no more. The Italians were to share half the profits but their salaries must not be paid in beads. They must take their half in other commodities. This left the officials in control of the coinage.

When Captain Norton arrived with his glass-makers and their supplies Jamestown was still more of a pest-house than the Utopia it hoped to become. Captain Norton was "A Surgeon of no mean skill." He was also a great-hearted man who, seeing the need of the poor, suffering people, threw himself into the battle against disease and by saving other lives lost his own to the great sorrow of the whole colony. Immediately George Sandys stepped into the breach, adding to his many hard problems as treasurer, the business of superintending the making of glass and the establishment of "America's first Mint!" He had a hard time of it and so did the Italians.

Like the foreign glass-makers of England the Italians wished it understood that they were "gentlemen." The English gentlemen of George Sandys' breed had put aside affectation, pride and the love of soft living. They were ready to take off their coats, do a man's job and if necessary even roll up their sleeves. George Sandys would much rather write a poem than dig a ditch or fell a tree or fight the Indians but he stood ready for any necessary service and could not understand these temperamental, artistic gentlemen. On the other hand, the poor Italians could not understand George Sandys. They had received a terrific shock, transferred to this wild land. Accustomed to protection in Italy and to reverence for their skill, here they felt helpless and underestimated. Life was one long hardship. Their very servants died one by one and even members of their own families. Added to bewilderment and sorrow, they were expected to make fine glass out of "impossible" native material.

This misunderstanding between the Italians and their Director expressed itself in bitterness and George Sandys sometimes used very unpoetic language in dealing with his rebellious workmen. Writing to England at this time he said that he had sent his shallop to Cape Henry for sand for the glass-men but requested than sand be sent from England in case the sand from the Cape "be not liked in the trial."

And the Italians were right in the matter of sand. How could they make their beautiful things from the sand which the Poles used for their bottles? Digging into

old Jamestown after the lapse of three centuries I found specimens of the early glass they made which proved that they had good reason to complain.

The most valued object in my collection is a large bottle or vase which may have been made of English sand sent to George Sandys. It was not dug up but has been preserved from very early days and handed down from one generation to another as a piece of glass made at the First Glasshouse in Virginia. The descendants of the original owners live a few miles from the ancient furnace and comparing it with glass fragments from Surrey-Sussex district it seems certainly of that period. It is a large piece 14 inches high and its circumference at the bulge is 28 inches. It has the ogee base, similar to that of the wine bottles attributed to the Italians and the film of glass, made by a hollow pontee in the center of the base, is the same as the Italian wine bottle base. The large turned outward mouth is like the Chiddingfield bottle fragments, exhibited in the Guildford Museum, England. The glass which was once probably very clear has now a dark smoky tint which is similar to that of two small measuring glasses brought from England which belong to the early 17th century and are in my collection.

The glass fragments of Italian workmanship show several kinds of sand. Some of this glass has changed to a milky tint and some is a clear crystal. The bases of the small bottles have an arch coming to a point. The shapes are perfect and beautifully preserved.

I found part of a drinking glass imbedded in hard dry clay. It had changed to an almost opalescent tint. It was very thin and came apart in flakes as mica does.

On the site of the old furnace I picked up part of a base which was very thin and had a tint slightly yellow and also a little nugget of glass which had turned almost black and may be of the same composition as my perfect bottle.

It is probable that the Italians made the first gourd-shaped wine bottles. The bases which I have classified as made by them are very thick although the sides are thin. Like all Virginia-made bottles there is no crude pontil mark. A thin film like tissue paper shows where the pontil held but often this is absent.

The necks of these old wine bottles have a square ring of glass applied to the neck about a half-inch from the mouth. As time advances these collars are lifted nearer to the mouth until at the end of the 18th century they are almost flush with it. After the first period instead of being square-cut they form an angle of about 45 degrees. One can almost tell the date of a gourd-shaped neck by the way the collar is applied.

But the most interesting find near the old Italian furnace was three clear glass bottle necks and shoulders. with "turned outward mouths." Two of them were sprinkled over with grains of sand. Evidently these particles were too hard to fuse at the temperature they were able to obtain and it is no wonder that the poor Italians "did not like it!"

The owner of the furnace showed me what he said was the only scrap of manufactured glass found at the site. It was a small piece of this same sand-covered metal so Evidently the three necks were made at that furnace. There is no difficulty at all in identifying the Italian glass. It is clear, well polished and with seldom any opalescence or other mark of degeneration.

There are many specimens of window glass; some pieces are beautifully iridescent, some are black and some have the appearance of highly burnished gold.

The following comparison of compositions forms an interesting study and seems to indicate that the Italians who made glass at Jamestown inherited their knowledge from a long line of Roman ancestors who in turn obtained it from the ancient Egyptians.

Sample 1 was taken from large opalescent beads, doubtless made by the Italians in Virginia, 1622-1630. The analysis was made by Dr. V. C. Swicker of the Hartford-Empire Company.

Sample 2 is from a museum specimen from Tel el Amarna, Egypt, 1400 B.C. It is taken from Dr. Sharp's chart, "Industrial and Engineering Chemistry," July, 1933.

Sample 1. 1622	*Per cent*		*Sample 2. 1400 B.C.*	*Per cent*
SiO_2	60.28		SiO_2	63.72
Fe_2O_3	0.114		Fe_2O_3	0.54
Al_2O_3	0.85		Al_2O_3	1.04
CaO	10.30		CaO	9.13
MgO	0.53	10.83	MgO	5.20
Na_2O	1.08		NaO	20.63
K_2O	18.04	19.12	K_2O	0.41
F	1.27			
P_2O_5	8.01			
Cl	0.26			
	100.73			

FIBERGLAS TEXTILES ARE SOLD IN MANY RETAIL STORES

Many glass men will be surprised to learn that textiles made of glass fiber are now being sold in quantity in the retail market through various stores specializing in quality materials. This rapid progress of the new material has been due primarily to progress in its weaving and to the variety of colors in which it is now available.

For example, Fiberglas drapery fabrics are being featured in the following weaves: Bubble cloth, satin stripe, grosgrain and shell damask in 50 to 70 inch widths. The color range for this particular item includes pure white, light and dark ecru, a light periwinkle blue and a medium dark periwinkle blue.

Among items which have won immediate popularity are shower curtains of Fiberglas, lamp shades and gauze and net curtains.

Over 40 industries, producing chemical materials and equipment, will display their newest products at the Seventeenth Exposition of Chemical Industries. The Exposition, for which nearly 300 exhibitors have taken space will be held at the Grand Central Palace, New York, during the week of December 4th to 9th.

NEW YORK CERAMIC ASSOCIATION TO MEET

The Sixth Annual Meeting of the New York State Ceramic Association will be held at the Ceramic College of Alfred University, Alfred, N. Y., on Friday, Oct. 20th. The program will consist of the presentation of the research work of the Ceramic Experiment Station for the year 1938-39. Everyone interested will be welcome.

INVENTIONS AND INVENTORS

Summary of United States patents of interest to the glass industry issued during July and August.

Raw Materials and Compositions

George W. Morey has obtained a Reissue (No. 21,175) of his patent 2,150,694 assigned to the Eastman Kodak Co. This patent covers non-silicate glasses formed by the fusion of oxides, usually spoken of as "rare" and with little or no previous use in commercial glasses. Lanthanum and tantalum oxides were found to be useful, especially in combination with other oxides, such as those of titanium, thorium, zirconium, and tungsten. Ordinarily, optical glasses having an index of refraction greater than 1.65 are limited in light dispersion characteristics. It is reported that the new compositions produce excellent optical glasses, having extremely high indices of refraction and lower dispersions than glasses of the flint series.

Following are some of the percentage compositions considered within the range of Dr. Morey's invention: invention:

	B	*I*	*K*	*L*	*T*
Titanium*	40	—	—	17	—
Lanthanum*	—	26.3	49.2	60	33
Tantalum*	45	26.3	23	—	—
Thorium*	—	20.2	9.8	—	41
Zirconium*	15	—	4.9	8.5	—
Boron*	—	22.7	9.8	12.5	26
Borax	—	4.5	3.3	2	—

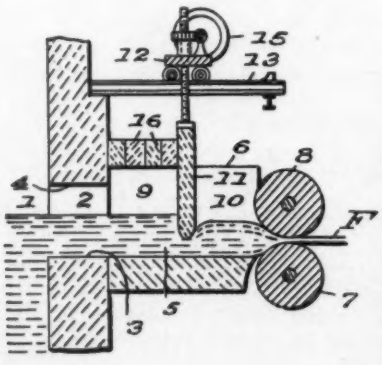
*Oxides.

Furnace Equipment

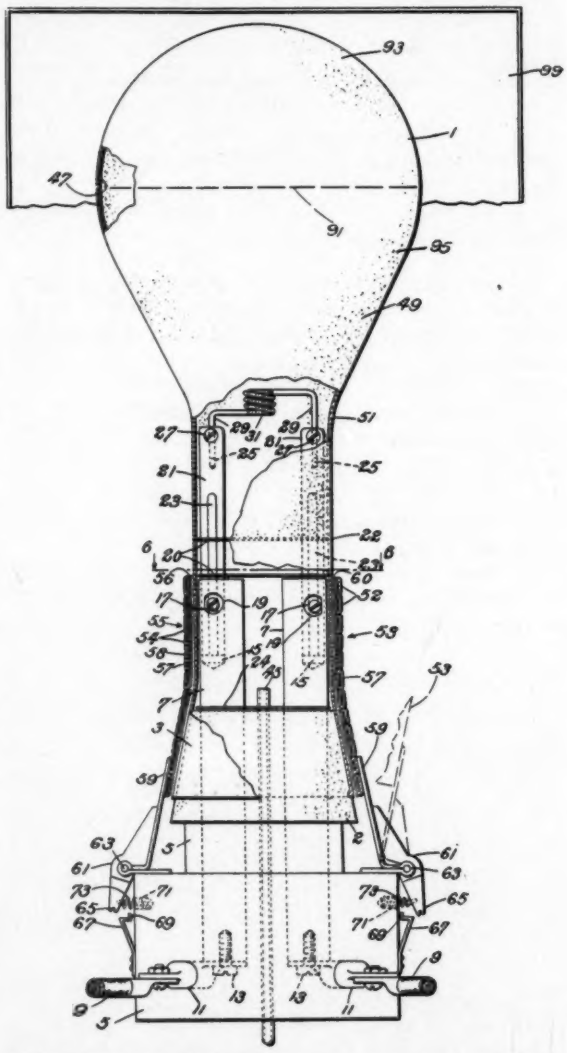
Glenn H. McIntyre and George R. Sylvester are the inventors of an annular rotating-hearth porcelain enamel furnace, which is said to be adaptable also for the manufacture of clear glass (2,169,611, Ferro Enamel Corp.) Continuous furnaces have been uncommon in preparing porcelain enamels, probably because of the extraordinary requirements for a long refining period to provide even distribution of the opacifying agents.

Patent 2,169,429, assigned by its inventor, Thomas F. Pearson, Pontefract, England, to Crown Cork & Seal Company, Inc., is concerned with a skimming device. The apparatus comprises a refractory bridge space back of the front wall of the forehearth, with its bottom surface above the tank floor and its upper surface submerged below the metal line, and a skimmer which moves through the glass from the front wall to a position to the rear of the bridge, at which position its removal from the glass permits the skimmed material to drain from the skimmer. Another patent taken out by Mr. Pearson (2,171,096) and also assigned to Crown Cork & Seal Co. represented an apparatus for feeding molten glass from a furnace by suction.

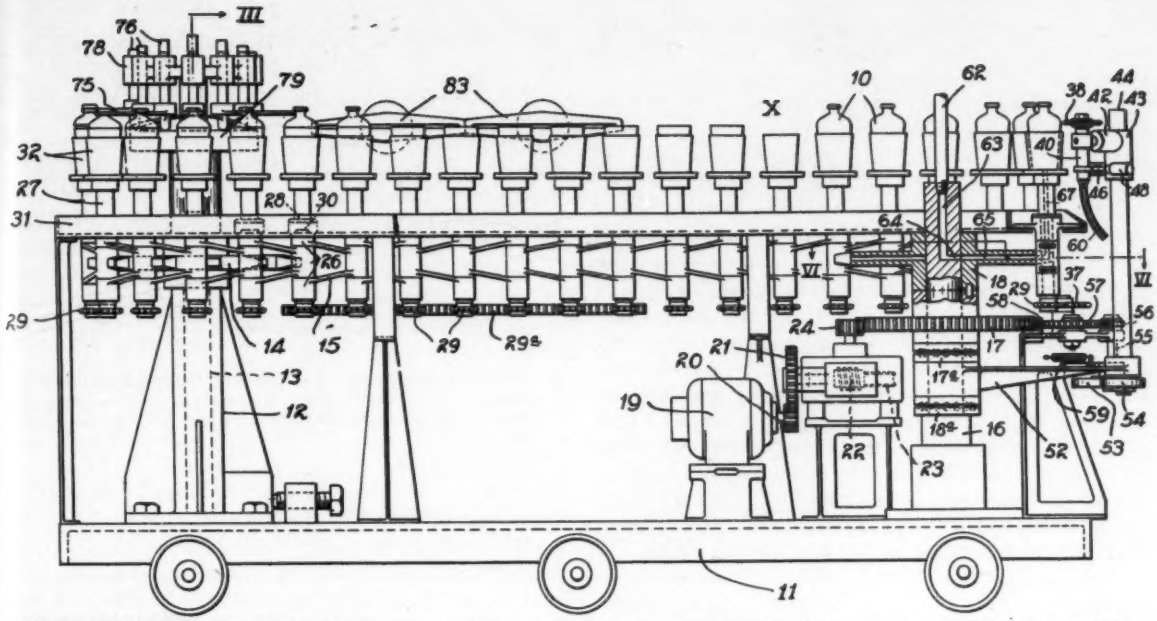
Louis Boudin, Saint Gobain, France, obtained a patent, 2,167,290, on apparatus involving plate glass tank furnaces with an outside cooling reservoir as in his earlier patent, 1,859,862, granted in 1932. (See illustration.) An improvement is the introduction of a movable partition which varies the amount of the outside reservoir available for cooling. The patent has been assigned to



2,167,290: Boudin. This patent concerns a glass tank with an outside reservoir for controlled cooling of the molten glass. The length of the cooling chamber can be altered by moving the partition wall (11).



2,164,332: Macksoud. In an apparatus for silvering lamp bulb interiors the metal is vaporized within the neck of the bulb in a crucible heated by high-frequency induction.



2,169,455: Wagner. **This continuous machine carries out the various operations of severing the tops from blown tumblers and finishing their edges.**

Societe Anonyme des Manufactures des Glaces et Products Chemiques de Saint Gobain, Chauny et Cirey, Paris, France.

Forming and Shaping

An invention of Frank L. O. Wadsworth, deceased, assigned to Ball Brothers Co., patent 2,166,563, is concerned with means for severing mould charges and accelerating their velocity so greatly that the impact of the charge on the bottom of the mould will cause the charge to spread out and completely fill the mould cavity. A feeder arrangement is also covered by patent 2,165,873 granted to Edgar Jacob Rush, Lancaster, Ohio.

Paul R. Luertzing of Vineland, N. J., patented (2,166,871) a method and apparatus for making glass containers or other articles, open at both ends and formed from glass tubing in a continuous series of automatic operations, including all steps from drawing to the completion of forming.

Decoration

Louis E. Rice, Washington, Penna., invented a machine for simultaneously engraving duplicate patterns on a number of articles. The articles are held in a series of supports which provide universal movement relative to the engraving wheels, whereby the ware may be turned or oscillated on two perpendicularly related axes, and whereby movement applied to any one article is transmitted in a duplicating manner to each of the other articles (2,171,007).

A process for etching glass ware was patented by David I. Du Bois and assigned to the Armstrong Cork Co. (2,166,428). The patent claims a method, including the following steps performed while continuously moving glass articles: Subjecting them to an etching spray, tilting the articles to drain it away while submitting them to an air jet, passing them through a dripping and fume removing zone, subjecting them to a cold water spray, then through a second dripping and fume removing zone, subjecting the articles to a spray of hot water, tilting to drain water from the tops of the articles, and treating the articles with heated air currents to dry them.

Miscellaneous Processes

Francesco Satragno of Rome, Italy, patented an apparatus for applying a sanitary strip to the edge of drinking glasses and cups (2,167,728). Patent 2,171,085 granted to Hjalmar Friberg of Stora Essingen, Sweden, is a bottle labeling machine.

Wm. A. Maher assigned to the Crowe Name Plate & Mfg. Co. of Chicago, his patent 2,168,650 covering apparatus for sand blasting mounting-holes in glass plates. The work is protected by masks and blasted from both faces.

Patent 2,167,482, which Albert W. Hull and Emmett E. Burger assigned to General Electric Co., covers a seal between iron-nickel alloys (39 to 43 per cent N.) and a glass with similar thermal contraction characteristics, containing 50 to 64 per cent silica, 29 to 40 per cent boric oxide, and about 2 to 7 per cent alkali material. Contraction data on various glasses and alloys form a part of the patent specification.

Simply constructed bottle breaking equipment to prevent unauthorized refilling of liquor bottles, was covered in three patents. These were 2,167,040 to L. S. Farner, H. L. Beals and A. A. Haladik, of New Kensington, Penna.; 2,168,026 to Adam Fritz of Philadelphia, Pa.; and 2,168,226 to Wm. Lieb of Detroit, Mich.

For applying a mirrored surface to the interior of lamp bulbs, Michael E. Macksoud of Gloucester, Mass., provides in patent 2,164,332 (Birdseye Electric Co.) an apparatus wherein silver, aluminum, or other suitable metals are vaporized in a coil-heated chamber which extends within the neck of the bulb. (See illustration.)

The assembly is air tight to provide for removal of air from the bulb before vaporizing the metal. The technique is treated at length in the patent specification.

In producing a composite lens Theodore W. Buttner claimed a process wherein two lenses touching only at their edges, are brought to a temperature below their melting point, the heating chamber evacuated, the edges fused together by a flash of heat which does not distort the body portion of the lenses, and the chamber cooled slowly to anneal the composite lens. (2,169,404 assigned to Robinson-Houchin Optical Co., Columbus, O.).

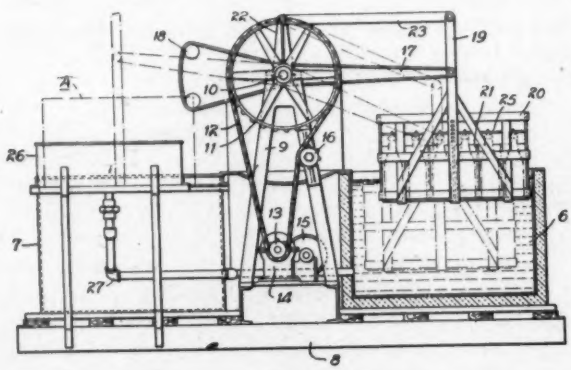
Patent 2,169,455 to Wm. L. Wagner, Sr. of Glenshaw, Penna., claims improvements in the apparatus for finishing blown tumblers, etc., from bottle-like shapes, from which the upper necked portion must be removed and the upper edge of the body subsequently glazed. (See illustration.) The Wagner invention provides apparatus for scoring the entire periphery of the blanks along the line at which they are to be cracked off, the application of a knife edge flame to the scoring line, the removal of the top, and the glazing of the edge of the article.

Testing

The bottle testing investigations carried out under the direction of Dr. Frank Preston were discussed in an article in the August, 1938, issue of THE GLASS INDUSTRY, which surveyed the personnel and equipment at his glass testing laboratory near Butler, Penna. Testing equipment is only infrequently patented in this country, but occasionally this protection is necessary to control the design of apparatus, and thus to aid in standardizing testing procedures. Dr. Preston has been granted a patent (2,167,185) covering an apparatus for testing bottles by thermal shock. (See illustration.) A number of bottles in a tray are alternately immersed in hot and cold water in a machine which automatically controls the time intervals as well as other important details of the test method.

Glass Blocks

That the number of good cementing and bonding agents available for outdoors application is really very small, became evident when the use of glass blocks for exterior walls was begun. One cement which received consideration was the mixture of caustic magnesite and magnesium chloride which is known as magnesium oxychloride, or Sorel cement (after the Frenchman who invented it in 1866). The adherence of oxychloride cement to glass and to many other materials was well known, but the disintegration of the many magnesia stucco walls built in the early 1920's was a deterrent. However, interest in this cement has been revised since 1936, when it was announced that Dean S. Hubbell, a Fellow at Mellon Institute, had apparently solved the weathering problem by the incorporation of about 10 per cent of finely pulverized copper in oxychloride cement (Pats. 2,058,984; 2,058,985; 2,058,986). The use of this new copper-magnesium oxychloride cement for laying up glass blocks, is covered in Mr. Hubbell's newest patent, 2,164,457, assigned to the H. H. Robertson Co.



2,167,185: Preston. Dr. Frank Preston's machine for testing thermal shock resistance of bottles.

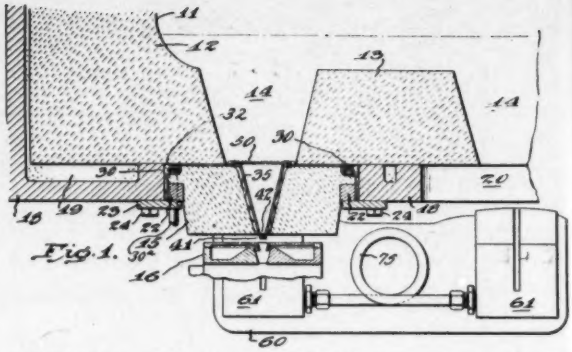


Fig. 1.

2,165,318: Thomas. For feeding fine streams of molten glass in fiber production, the water-cooled bushing 15 is lined with platinum-rhodium metal having apertures at 42.

A different type of attack is represented by John E. Bauer's patent 2,170,602 assigned to Owens-Illinois Glass Co. In the production of the glass blocks the mortar-bearing surface is treated, while still hot from forming, with an affinitive molten metal and then with a gritty material which adheres to the metal before it sets. These steps precede the annealing process.

In the block patented by Aldo Favoron of Milan, Italy, ("Fidenza" Società Anonima Vetraria), only the front and back faces are glass, these being formed with recesses into which are fitted cheap non-vitreous side plates, such as cardboard, celluloid, etc., which form, with the ends of the glass plates, a recess for receiving the mortar (2,168,287).

William O. Lytle's patent 2,167,764 (Pittsburgh Plate Glass Co.) covers the use of one or more sheets of transparent non-shatterable material, such as a suitable vinylacetal resin, used so as to seal together the opposing halves of the block and to divide the hollow space into two or more cells. It is reported that such a block is strengthened by the adhesive plastic sheet and that the heat insulating properties are improved.

Glass Wool and Fiber

In an apparatus for withdrawing a number of fine streams of glass from a furnace, John H. Thomas and Ed. Fletcher (Owens-Corning Fiberglas Corp. 2,165,318) have patented various details. (See illustration.) Of particular interest is the construction consisting of refractory bushings with V-shaped openings, which form the seating for platinum-rhodium liners that converge at the

bottom to provide a series of fine holes through which streams are drawn. Water cooling serves to freeze the glass which might leak around the bushing, while heating elements maintain predetermined temperatures in the trough and thus control the drawing characteristics.

George M. Lannan, of the same company, patented (2,165,280) an improvement in means for forming a fiber mat or bat. When fibers are deposited on a belt or other elongated surface, there is a tendency for a more shallow deposition at the edges than in the middle. In Mr. Lannan's process, this marginal material is severed and turned to overlie the adjacent fiber. (Illustration.)

Plates and Sheets

Achille Verlay of Longueil-Annel, France, patented (2,167,318) a means for bending glass sheets which was assigned to Societe Anonyme des Manufactures des Glaces & Produits Chemiques de Saint-Gobain, Chauny & Cirey, Paris. The apparatus provides means for heating and bending a sheet while held by a series of supporting means, engaging the sheet at points near its upper edge, such supporting units being free to move laterally with the sheet, and to turn on a vertical axis with the sheet while it is being bent. The same company was also assignee of Georges Monnet's patent 2,164,418 covering means of surfacing glass by means of an apparatus provided with numerous resilient blades which affect the treatment with the aid of the usual abrasive agents.

Patents 2,168,220 and 2,168,221, assigned by Edwin H. Land to Polaroid Corp., claim new developments in laminated light polarizers. In the first of these, a sheet of polarizing material, such as that sold as Polaroid, is sandwiched between two glass sheets with adhesives, such as vinyl compounds.

Two Libbey-Owens-Ford patents were concerned with apparatus for tempering glass sheets, according to the well-known process wherein the sheets are first heated to approximately their point of softening and are then suddenly chilled to place the outer surfaces under compression and the interiors under tension. One of these patents (George R. Ford, Jr., 2,166,348) is a semi-continuous process utilizing a compartment furnace in which a number of sheets are simultaneously in various stages of heating or chilling. Improvement in the cooling apparatus is the aim of patent 2,166,427 (John L. Drake) which provides novel apparatus for the mounting and oscillatory movement of the blower heads used for this purpose. A third Libbey-Owens-Ford patent (2,169,677, Charles D. Burrell) discloses an apparatus for packing sheets in a freight car, and a fourth is an electrical apparatus for the template cutting of glass sheets. Those interested in the latter patent (2,169,687; I. G. Fowler and John L. Drake) will likewise find interest in the related subject matter of patent 2,146,373 which issued earlier this year to Edwin W. Keir.

William Owen's patent (2,169,739) assigned to Pittsburgh Plate Glass Co., covers an apparatus for carrying out a glass plate handling operation. One handling frame equipped with vacuum cups picks up glass sheets from cars on one track and rotates to expose the free side of the plates, releasing them to a second frame which places the sheets on cars on a second parallel track.

In the hardening of plate glass or window glass by streams of air, Georges Paul Despret of Paris proposes (2,167,294, assigned to the American Security Co.) the replacement of stationary perforated tubes and other air supply sources by moving jets which cool the sheet more uniformly. By the use of the various forms covered by his patent, it is claimed that evidences of wavings or colorings are no longer developed. Lewis Jex-Blake Forbes of St. Helens, England, assigned to the same company his patent 2,170,749 covering a multi-stage tempering furnace for glass plates.

Patent 2,167,905 to Ingvald O. Pedersen and Clarence P. Byrnes is concerned with improvements in the process of continuously drawing and processing sheet glass.

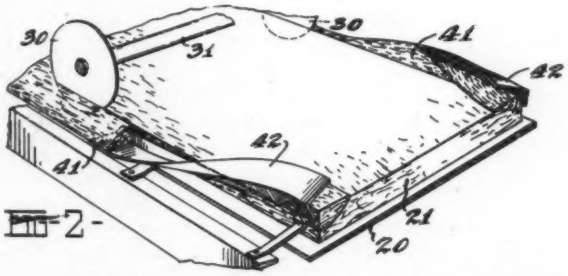
New Products and New Uses

New products included an iced cocktail container in which the glass stands in a cup with perforated walls which itself stands in an ice bowl (Judson L. Bickerstaff, Biloxi, Miss., 2,168,969); a coffee-making apparatus (2,171,321 to Theodore C. Miller, of New York); a glazing bar, (2,171,319 to Jack Williams, London, England); and a ground glass joint into which a glaze composition having softening point below that of the glass, is fused (2,169,194 to Wm. O. Geyer and Chas. A. Weller, Bloomfield, N. J.).

Nils H. Cederquist, Los Angeles, patented a glass tile indoor construction (2,169,720) in which plate glass tiles with beveled outer edges overlay a fibrous material such as burlap with a grouting material penetrating the burlap and extending onto the beveled edges, so as to hold the tiles in place. The rear faces of the tiles are protected by paper to prevent any damaging effect the cement might have on enamel colors applied to the backs of the tiles.

Plate glass window mounting was featured in two patents granted to Oliver M. Edwards of the O. M. Edwards Co., Inc., Syracuse, one to William Owen of the Pittsburgh Plate Glass Co., and a fourth to Chas. A. Stroud of the latter company. The Edwards patents 2,167,973 and 2,167,974 describe an elastic tire-like frame which holds the glass panes, and pressure applying means to improve the contact of the frame and glass. In Owen's patent 2,167,772 the unit bearing the glass panes is held in place by wedges kept compressed by resilient strip. Stroud's patent 2,169,713 also provides a wedged system of holding a double plate window in place.

Patent 2,169,426 granted to Wm. A. Morton (Amco Co., Pittsburgh) is a tumbler with threaded base intended to screw into a holder which may be wholly of metal or partly of glass and metal. The product is claimed to have a non-sweating exterior.



2,165,280: Lannan. The edges of the glass fiber matting are cut and turned back so as to equalize the thickness of the mat.

OCCUPATIONAL DISEASES IN THE GLASS INDUSTRY

In *Glastechnische Berichte* for May, 1939, Hans Otto makes an exhaustive report on the health and accident risks in the glass industry, from the point of view of developing measures for governmental control of working conditions. Following the cheerful habit of medical men, Dr. Otto omits nothing and draws a picture of the glass industry as it affects the human body that might well frighten anyone unacquainted with the actual circumstances and the comparative infrequency of the various diseases which he describes.

The glass industry, Doctor Otto says, offers a special opportunity for diseases and accidents because of the variety of chemicals used, the dusty condition of some work-rooms, the heat and glare of the furnaces, and the heavy work required. As he remarks, it is essential that protection of the workmen from accident and the improvement of hygienic conditions must go hand in hand. Some of these injuries and infirmities are of accidental origin and the rest are the result of unfavorable surroundings.

The diseases are catalogued according to the specific duties which give rise to them, somewhat as follows: 1) among furnace men, melters, and blowers: fire cataract, gastric intestinal catarrh, and rheumatic illnesses. 2) among glass blowers: swelling of the parotid glands, destruction of the teeth, over-expanded lungs, hooked hands, water itch. 3) among glass polishers: silicosis of the lungs, inflammation of mucous membranes, and wrist paralysis. 4) among batch handlers: lead and arsenic poisoning, silicosis, and cataract formation. 5) among those who charge the batch, attend its melting, and make pots and blocks: the same illnesses as under (4). 6) among teasers: carbon monoxide, lead and arsenic poisoning. 7) polishing rooms and cullet grinding rooms: silicosis. 8) in etching shops: skin lesions, injuries to eyes, nasal passages, the stomach, and other difficulties due to the manifold variety of fluorine poisoning. 9) in painting and spraying: chiefly lead poisoning. 10) in sand blasting: heavily-dusted lungs.

These occupational diseases and infirmities are further classified as A) typical diseases peculiar to this industry; B) more or less chronic occupational diseases which do not make the sufferer unfit for duty but make him less effective and quite unhappy in his work; C) pure accidents which also arise in other industries and are not peculiar to this one. It is unnecessary here to repeat this classification in detail.

Long paragraphs are given to detailed description of the various diseases outlined above. An interesting point is made in connection with arsenic poisoning which is that the gas, arsine (AsH_3) which may be a vaporized product from a glass batch containing arsenic, is between ten and twenty times more poisonous than carbon monoxide. Another poison mentioned and one that is not often noticed is manganese. It is taken into the human system by the inhalation of dust or vapors containing the element. This element poisons the central nervous system and results, according to Dr. Otto, in extreme cases, in lack of facial control, loss of memory and destruction of sense perceptions. This last defect seems to be manifested in a peculiar form of color blindness. It is remarked that severe poisoning may occur after three months' exposure to quantities of manganese dust by inhalation.

Rather solemn warnings are given about carbon monoxide poisoning. The more acute forms of this poison, as by sudden exposure to high concentration of the gas, are fairly well known. It is not so well recognized that long exposure to very small concentrations of CO may result in chronic poisoning. Some of the results are nervous disorders, headaches, sleepiness, neuralgia, anemia, gastro-intestinal difficulties, trouble with balance and with speech, and others. These symptoms may often be assigned to the wrong causes, with results often fatal to the suffered from CO poisoning. The only treatment is the immediate removal from the poisonous atmosphere, followed by prompt administration of oxygen mixed with about 5 per cent carbon-dioxide, also aids to circulation and heart action, and possibly blood transfusion.

The writer pays particular attention to silicosis, pointing out that this is the result of inhalation of dust composed of silica itself in particles of one to eight (.001-.008 mm.) in size. Such particles are about as large as bacteria and are, of course, invisible. Consequently, the dust hazard is often unnoticed, because visible clouds of dust are not present. Dr. Otto makes the reasonable suggestion that crushed steel be substituted for sand in the sand blasting or other dry grinding operations.

The simple enumeration of so many diseases associated with the glass industry, and the recognition of their presence among us, is enough to confirm factory executives in the establishment of the very best working conditions possible. The workman, on his part, can cooperate by making use of respirators, and other protective devices, however uncomfortable temporarily. Personal cleanliness and care on the part of the workmen are most essential in the prevention of disease and accident.

SERVICE IS RENDERED BY INSTITUTE OF CERAMIC ENGINEERS

The value of the Institute of Ceramic Engineers was demonstrated in the case of the engineers' licensing bill (S1128) for the District of Columbia. As originally written, the bill did not include ceramic engineers, and had it passed in this form, this group could not have practiced professionally in the District. Upon being advised of this situation by the American Engineering Council, the Executive Committee of the Institute immediately communicated with senators and representatives from such states as Ohio and Pennsylvania, where ceramic industries are strongly represented. As a result of these efforts the House sub-committee of the District of Columbia included ceramic engineers in the bill.

While it was realized that few ceramic engineers would take advantage of the act to obtain professional licenses in D. C., it appeared to be extremely important that they be included because of the influences such inclusion by Congress would have on State Boards of Examiners that have not as yet recognized ceramic engineering.

EQUIPMENT AND SUPPLIES

NEW "EKKO" METHOD WILL MAKE GLASSWARE MOLDS DIRECT FROM ORIGINAL PLASTER OR WOOD PATTERN

A new method for preparing molds and dies has just been announced by the United States Rubber Co. It permits of accurate and faithful reproductions of intricate patterns and difficult shapes in iron from the original wood, plaster or plastic mold, eliminating entirely the costly tooled and engraved master mold. The process is expected to effect tremendous savings in many industries, notably glass.

United States Rubber Company has named its new process EKKO, a phonetic spelling of "echo" and suggestive of its duplicating nature. The process was developed first for making tire molds, after which its usefulness in other fields readily became apparent. Experimental work conducted with glass manufacturers has demonstrated its suitability for objects made of this material, of which the headlight lenses shown in the accompanying illustration are an example.

The EKKO process produces molds and dies by electroforming iron against a pattern it is desired to reproduce. Electroforming is the same as electroplating, except that deposits of far greater thickness are achieved instead of the thousandths-of-an-inch coatings applied by electro-plating. Continued experience on the part of the inventors is resulting in their being able to step up the thickness of the coating; for example, whereas only a few weeks ago ⅜ in. coatings were maximum, now ½ in. has been attained, and much thicker molds are anticipated almost from day to day.

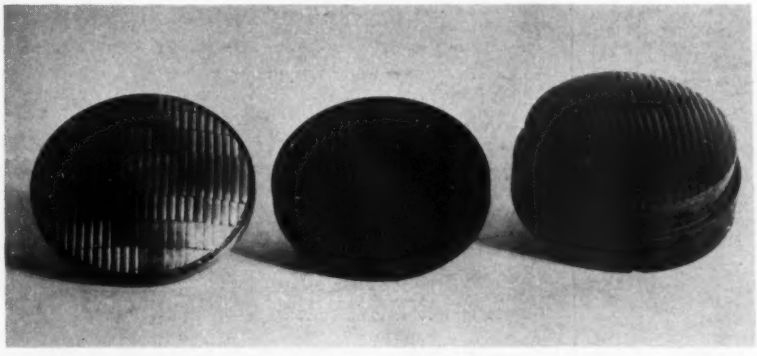
The process is limited to iron deposits, and the iron produced by the electroforming process is 99.98 per cent pure. It is substantially free from porosity. When plated it is about 50 per cent harder than cold rolled steel and gives a Brinell reading of 240. The metal can be softened to the normal value of pure iron by annealing or can be hardened by carburizing so that it will scratch glass. Electrolytic iron has a heat conductivity nearly twice that of cast iron or steel, which is a special advantage in molding operations where a high rate of heat transfer is desirable.

NEW SWEATBANDS

The O. Hommel Co., ceramic suppliers, have recently introduced a new, cool, and comfortable sweatband which is manufactured from a special cellulose material absorbing about 20 times its weight in water. Before use the sweatband should be immersed in water and hand squeezed. It is easily washed out with soap and water as frequently as desired. Plant workers find them convenient, preventing perspiration from running into their eyes and also into ingredients that may be harmed by grimy sweat.

NEW LINK-BELT P.I.V. GEAR SIZES ANNOUNCED

Two new sizes of P.I.V. Gear variable speed transmission units are announced by Link-Belt Co., Philadelphia, and are described in a new 40-page book, No. 1574, seventh edition. They are No. 0 size, ½-h.p., for speed ratios of 2 to 1 or 3 to 1; and size No. ½, 1½-h.p., for ratios of 2 to 1, 3 to 1, 4 to 1. These smaller sizes, like the larger units, ranging up to 15-h.p. and up to 6 to 1 speed ratio, can be furnished for horizontal or vertical mounting, motorized or without integral motor, and with or without extra speed reduction gear sets. Other new items included in the book are vernier control for extra-fine speed variations; and a convenient table that makes it easy to select the proper size unit for the service.



The EKKO process applied to the glass industry. Right, an engraved plunger; and center the negative receiving the plunger. Left, the finished headlight pressed from glass.

PORTABLE CONVEYOR

A new roller-type portable conveyor made of 61 S. T. Alcoa Aluminum, featuring high tensile strength combined with light weight, has been placed upon the market by the Aluminum Ladder Co., 271 Adams St., Tarentum, Pa. It is equipped with steel ball bearing wheels fitted on an eccentric axle at each end of the conveyor. The rugged construction and high tensile strength of this new conveyor enable it to support extremely heavy loads. It will not rust or deteriorate in any way, and therefore will withstand years of severe service, and it is easy to clean.

The new conveyor can be supplied in varying widths, lengths and heights to suit different needs.

CATALOGS RECEIVED

Ingersoll-Rand Co., Phillipsburg, N. J., has issued a bulletin describing a new line of industrial compressors and vacuum pumps in sizes from ¾ through five HP. The catalog contains both installation and shop views of the machines, together with complete operating and physical characteristics of each. The complete line Ingersoll-Rand Type 30 compressors is also covered in this bulletin.

The General Refractories Co., Philadelphia, recently published a new book on Basic Refractories which contains valuable data on processes, application, use and construction. It has 32 illustrations, is printed in color, and covers the entire field of Basic Refractory service.

Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Catalog No. N-01-163, entitled "Metermax Combustion Control for Boiler Furnaces," is an illustrated 32-page booklet covering application of control to furnaces of every major type.

Matthews Conveyor Co., Elwood City, Pa. Conveyors Handbook, Catalog No. HB39, is an illustrated, pocket-size book of 384 pages which includes data on all the various types and sizes of Mathews equipment. The book is offered to engineers and plant operating men without obligation.

Jeffrey Manufacturing Co., Columbus, Ohio. General Catalog No. 87 illustrates and describes complete line of power drives and material handling equipment. To obtain a copy of the 960-page book request should be sent to the manufacturer on company letterhead.

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

Base Materials

		Carlots	Less Carlots
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	43.00	46.00
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00-16.00	18.00
Borax ($Na_2B_4O_7 10H_2O$)	lb.	....	....
Granulated	In bags, lb.	.0215	.027 -.0295
Powdered	In bags, lb.	.024	.0295-.032
Boric acid (H_3BO_3) granulated	In bags, lb.	.048	.054 - .0565
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith)	lb.	.0865-.0875	.0925
Synthetic (Artificial)	lb.	No supplies available.	
Feldspar—			
20 mesh	ton	11.00-13.25	
40 mesh	ton	11.50-13.75	
Granular	ton	11.75-14.00	
Semi-granular	ton	11.00-13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags			
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	28.00-29.00	....
In bags	ton	29.60-30.60	38.00-40.00
Kryolith (see Cryolite)			
Lead Oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.0755	....
In 5 Ton lots	lb.	....	.08½
Less than 5 Tons	lb.	....	.09
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	8.50	8.50
Burnt (CaO) ground, in bulk	ton	7.00	....
Burnt, ground, in paper sacks	ton	9.00	9.00
Burnt, ground, in 180 lb. drums	Per drum	1.60	1.70
Kiln Dried ($CaCO_3$) 10x30 mesh	ton	1.75	....
Kiln Dried ($CaCO_3$) 16x120 mesh	ton	1.75	....
Nepheline Syenite, f. o. b. shipping point	ton	12.00-14.00	....
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.065	.0675
Hydrated 80-85%	lb.	.055	.0575
Salt cake, glassmakers (Na_2SO_4)	ton	15.00-15.50	25.00
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat Per 100 lb	.95	....
In barrels	Per 100 lb.	1.35	....
In bags	Per 100 lb.	1.10	....
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	Per 100 lb.	....	2.50-2.90
95% and 97%			
Bulk	Per 100 lb.	1.35	....
200 lb. bags		1.415	1.44
100 lb. bags		1.45	1.475

Special Materials

		Carlots	Less Carlots
Aluminum hydrate (Al $(OH)_3$)	lb.	.029	.03½
Aluminum oxide (Al_2O_3)	lb.	.07	.09
Antimony oxide (Sb_2O_3)	lb.	No supplies available.	
Arsenic trioxide (As_2O_3) (dense white) 99%	lb.	.03	.03½
Barium nitrate ($Ba(NO_3)_2$)	lb.	....	Open price.
Pyrophyllite, (20% Al_2O_3)	ton	9.00	12.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.04-.04½	.04½-.05
Tin Oxide (SnO_2) in bbls.	lb.	Open price.	
Titanium Oxide (ceramic grade)			
In bags	lb.	.12	.12¼-.12¾
In barrels	lb.	.12¼	.12½-.13
Zinc Oxide (ZnO)			
American process, Bags	lb.	.06¾	.06½
White Seal, 150 lb. bbls.	lb.	.08¾	.09
Green Seal bags	lb.	.08	.08¼
Domestic White Seal bags	lb.	.08½	.08¾
Red Seal, bags	lb.	.07½	.07¾
Zircon			
Refined Granular (Milled .01-.02c higher)		.06½	.07-.08

Coloring Materials

		Carlots	Less Carlots
Barium selenite ($BaSeO_3$)	lb.	....	1.40-1.60
(Commercial, 25% Selenium)	lb.	....	.85
Cadmium sulphide (CdS)	lb.	....	.80-.90
Chromite (99% through 200 mesh)	ton	35.50	40.00
Chromite ore (air floated)	ton	55.00	58.00-73.00
Cerium hydrate—			
100 lb. drums and 600 lb. barrels	lb.	....	.60
Chrome Oxide Green, 400 lb. bbls.	lb.	....	.25-.28
Cobalt oxide (Co_2O_3)			
In bbls. 350 lbs. or more,	lb.	....	Open price
Less than 350 lbs.,	lb.	....	Open price
Copper oxide—			
Red (Cu_2O)	lb.	....	.165
Black (CuO)	lb.	....	.18-.19
Black prepared	lb.	....	.22
Iron Oxide—			
Red (Fe_2O_3)	lb.	....	.0425-.09
Black (Fe_3O_4)	lb.	.04½	.09
Iron Chromate	lb.	....	.035-.05
Lead Chromate ($PbCrO_4$) in bbls.	lb.	....	.145
Manganese, Black Oxide			
In Paper bags	ton	62.50	65.50
In Burlap bags	ton	64.25	67.25
In Casks	ton	66.50	69.50
Neodymium oxalate, 50 lb. drums	lb.	....	3.50
Nickel oxide (Ni_2O_3), black	lb.	....	.35-.40
Nickel monoxide (NiO), green	lb.	....	.35-.37
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08¾	.09-.09¼
Powdered	lb.	....	.09¼-.09¾
Potassium Chromate (K_2CrO_4) 100 lb. kegs	lb.	....	.27
Powder blue	lb.	....	.18-.20
Rare earth hydrate—			
100 lb. drums	lb.	....	.35
325 lb. barrels	lb.	....	.30
Selenium (Se) In 100 lb. lots	lb.	....	1.75
In lesser quantities	lb.	....	1.85
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¾	.07-.07¼
Sodium chromate (Na_2CrO_4) Anhydrous	lb.	.08½	.08¾-.08¾
Sodium selenite (Na_2SeO_3)	lb.	....	1.50-1.65.
Sodium uranate (Na_2UO_4) Orange	lb.	....	1.75-1.80
Yellow	lb.	....	1.75-1.80
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.35	3.70-4.10
Flowers, in bags	Per 100 lb.	3.00	3.35-3.75
Flour, heavy, in 250 lb. bbls.	Per 100 lb.	2.90	3.25-3.65
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	....	2.65-2.75
Yellow orange	lb.	....	1.75-1.80

Polishing Materials

		Carlots	Less Carlots
Emery, Turkish	lb.	.063	.07
Pumice Stone,			
American Ground Italian FFF, FF, F	lb.	....	.03
0, 0½, ½, 1	lb.	....	.04
Putty Powder	lb.	Open price.	
Rotten Stone, (Domestic)	lb.	....	.03½
Rouge, Red	lb.	....	.16
Black	lb.	....	.18

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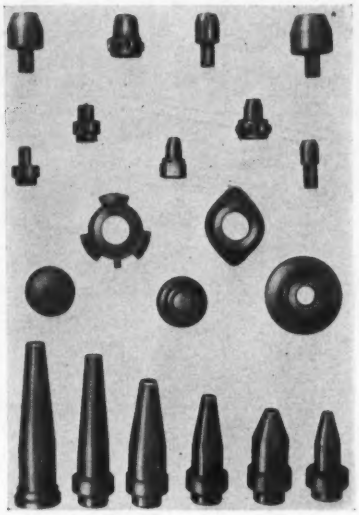

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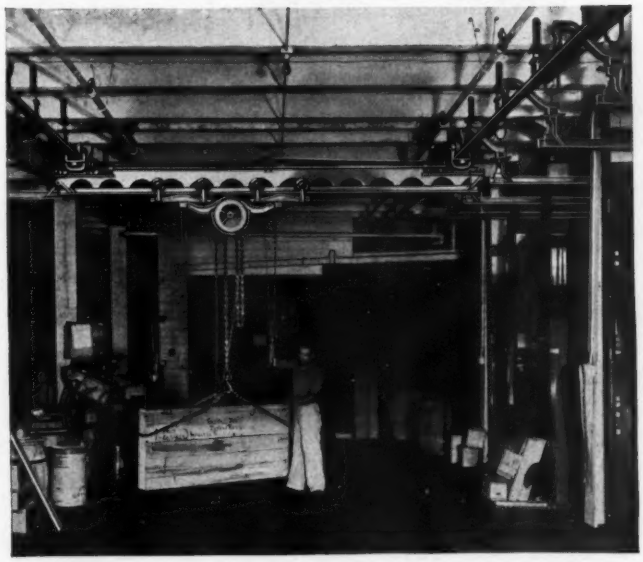

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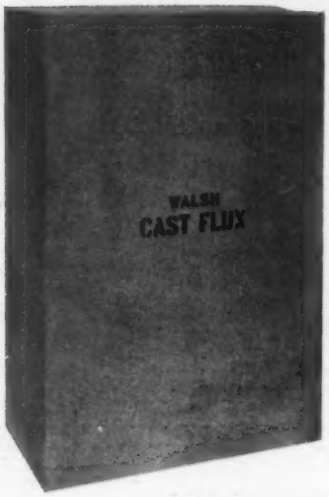

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Antimony	Magnesium Carbonate
Arsenic	Neodymium Oxalate
Barium Carbonate	Nickel Oxides
Bone Ash	Nickel Sulphate
Cadmium Oxide	Polishing Rouges
Cadmium Sulphide	Powder Blue
Cerium Hydrate	Putty Powders
Chrome Oxide Green	Rare Earths
Cobalt Oxide Black	Rutile Powdered
Copper Carbonate	Selenium
Copper Oxides	Sodium Selenite
Frosting Compounds	Sodium Uranate
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Iron Oxides	Whiting
Iron Sulphide	Zinc Oxides
Lead Chromates	Zirconium Oxide

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